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## CATASTROPHISM AND EVOLUTION.[1]

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WE have come together to-day to do honor to this young, strong institution. We are here that we may make the human circuit complete, and feel the current of a common pride glow from brain to brain. In celebrating the honest, manly growth of the Sheffield Scientific School, among the feelings which animate us veneration for antiquity finds no place. It is denied us to look back into the real past, for the brief lapse of thirty years compasses the life of the school. That short period, however, has amply sufficed to develop, with positive distinctness, the motive and animus of the institution. Its peculiar character is fixed. Reverence for natural truth and the deep, earnest, scientific methods of searching after it are what is taught here; so that we who have passed beyond these doors are gladly welcomed among that resolute band of nature-workers who both propel and guide the great plowshare of science on through the virgin sod of the unknown.

It is centuries too late to define or establish the value of science. Its numberless applications, which find daily expression in the material appointments of life, and serve to refine, to elevate, to render more admirable the mechanism of civilization, have long since put that question at rest. Let us hope that as a means of clearing away the endless rubbish of false ideas from the human intellect, for the lifting of man out of the dominion of ignorance, scientific method and scientific education are acknowledged to be adequate, if not supreme. We may congratulate ourselves, for that victory is won. At last modern society admits that a knowledge of the laws which govern the cognizable universe, and the possession of the only methods which can advance

[1] An address delivered at the Sheffield Scientific School at Yale College, New Haven, June 26, 1877.

that sort of knowledge, presupposes, nay, even develops, an intellect both vital and broad. If in America Science as a mode of education has won her way to the front, it is due, in prominent measure, to the honest training of the Sheffield Scientific School, and time will render this institution its unfailing reward.

Honored by the invitation to address you to-day, I have chosen to present a contribution to the theory of catastrophism and its connection with evolution, feeling that, however slight this contribution may be, as my own it is a direct outgrowth of this school, and that if I turn from the far greater and more attractive achievements of others, from the wealth of literary and philosophic materials which press forward for utterance, and bring here something which I have reached myself, it will afford you a more intimate interest. I have hoped, too, that other graduates might feel as I have, and that year by year men might stand here, fresh from the battle-field of life, out of the very heat of the strife, to tell us of their struggles, and hang the shields they have won along the walls of this temple of science. I ask you then to listen to a plain statement of my views of catastrophism and the evolution of environment.

The earliest geological induction of primeval man is the doctrine of terrestrial catastrophe. This ancient belief has its roots in the actual experience of man, who himself has been witness of certain terrible and destructive exhibitions of sudden, unusual telluric energy. Here in America our own species has seen the vast, massive eruptions of Pliocene basalt, the destructive invasion of northern lands by the slow-marching ice of the glacial period, has struggled with the hardly conceivable floods which marked the recession of the frozen age, has felt the solid earth shudder beneath its feet and the very continent change its configuration. Yet these phenomena are no longer repeated; nothing comparable with them ever now breaks the geologic calm.

Catastrophism is therefore the survival of a terrible impression burned in upon the very substance of human memory. The doctrine was also arrived at in very early times by our modern method of reasoning from marine fossils observed to be entombed in rocky beds far removed from the present seas, — beds which compel the natural inference that they are sea bottoms upheaved. This induction is poetically touched in the Rig Vedas, is stated in scientific method with surprising frequency among the Greeks, and recurs in the writings of most earth-students ever since.

Plutarch in his Morals gives a vivid account of an interview

between an Egyptian priest and wise Solon, who, in the open-mindedness of a truly great man searching after immemorial knowledge, had come to sit at his feet to listen. Calmly and with the few broad touches of a master, in that simple eloquence which comes of really knowing, the priest tells him of the catastrophes of submergence and upheaval which the earth's surface has suffered; and his method was identically ours of to-day. What a picture! Solon the wise, inheritor of the Hellenic culture, master of the polished learning of his country and his day, sitting within the shades of that hoary temple, listening devoutly to the words of one who spoke as out of the dark vault of the past and told how the solid continents were things of a time, born but lately from the womb of the sea.

When complete evidence of the antiquity of man in California and the catastrophes he has survived come to be generally understood, there will cease to be any wonder that a theory of the destructive in nature is an early, deeply rooted archaic belief, most powerful in its effect on the imagination. Catastrophe, speaking historically, is both an awful memory of mankind and a very early piece of pure scientific induction. After it came to be woven into the Sanskrit, Hebrew, and Mohammedan cosmogonies, its perpetuation was a matter of course.

From the believers in catastrophe there is, however, a totally different class of minds, whose dominant characteristic is a positive refusal to look further than the present, or to conceive conditions which their senses have never reported. They lack the very mechanism of imagination. They suffer from a species of intellectual near-sightedness too lamentably common among all grades and professions of men. They are bounded — I might almost say imprisoned — by the evident facts and ideas of their own to-day and their own environment. With that sort of detective sharpness of vision which is often characteristic of those who cannot see far beyond their noses, these men have most ably accumulated an impressive array of geological facts relating to the existing operation of natural laws. They have saturated themselves with the present *modus operandi* of geological energy, and culminating in Lyell have founded the British School of Uniformitarianism.

Men are born either catastrophists or uniformitarians. You may divide the race into imaginative people who believe in all sorts of impending crises, — physical, social, political, — and others who anchor their very souls *in statu quo*. There are men

who build arks straight through their natural lives, ready for the first sprinkle, and there are others who do not watch Old Probabilities or even own an umbrella. This fundamental differentiation expresses itself in geology by means of the two historic sects of catastrophists and uniformitarians. Catastrophism, I doubt not, was the only school among the Pliocene Californians after their families and the familiar fauna and flora of their environment had been swept out of existence by basalts and floods. As understood by archaic man, by the Orientals, the early Egyptians, the Greeks, the Arabs, and indeed until modified within the century by the growing belief in derivative genesis, or by the unbroken continuity of organic life from its first introduction on the planet, catastrophism was briefly this: —

The pre-human history of the planet has been variously estimated in time, from two days — the period assigned by the Koran — to an indefinite extension of ages. The globe having cooled from a condition of igneous fluidity received upon its surface of congealed primitive rock the condensed aerial waters, which formed at first a general oceanic envelope, swathing the whole earth. Out of this universal sea emerged continents; and as soon as the temperature and atmospheric conditions were suitable, low organisms, both of the vegetable and animal kingdoms, were created, and the complex machinery of life set in successful motion.

The great obvious changes in the rocky crust were referred to a few processes: the subaerial decay of continents, delivery of land-detritus by streams into the sea, the spreading out of these comminuted materials upon a pelagic floor, and lastly upheaval, by which oceanic beds were lifted up into subsequent land masses. All these processes are held to have been more rapid in the past than now. Suddenness, world-wide destructiveness, are the characteristics of geological changes, as believed in by orthodox catastrophists. Periods of calm, like the present, suddenly terminated by brief catastrophic epochs, form the groundwork of this school. Successive faunas and floras were created only to be extinguished by general cataclysms.

From all these tenets the modern uniformitarian school dissents only so far as to hold that the processes have not necessarily been more rapidly accomplished than at the rate we witness to-day. The facts of one school are the facts of the other. Both read the record of upheaval and subsidence, of corrugation and crumpling of the great mountain chains alike. One meas-

ures the rate of past geological action by the phenomena of to-day; the other asserts that the present furnishes absolutely no key. This irreconcilable difference finds its most pronounced expression when applied to the past history of life on the planet. If catastrophes extirpated all life at oft-repeated intervals from the time of its earliest introduction, then creation must necessarily have been as often repeated. If this is the case, it is plain that the Creator took pains each time to improve on the lately obliterated forms. If, on the other hand, the uniformitarian biologists are correct in their belief of the descent of all animal life from one or a few primeval types, then catastrophes of a universally destructive character cannot have occurred, and the changes which are proven to have taken place in the earth's surface may have been as moderate and harmless as they maintain. The uniformitarians reject the idea of a rapid and destructive rate of geological revolution in the past, first, because the present course of nature offers no parallel suddenness of action; and, secondly, because they conceive that nature never moves by leaps. They derive great comfort from quoting the well-known saying of Aristotle, that "Nature never does with her greater what she can do with her less." They are especially fond of objecting to catastrophes on account of the vast force necessitated. I confess that this seems to me a singularly fallacious view. Absolutely identical expenditures of energy are required to elevate a continent or depress an ocean basin given distances, whether the operation is instantaneous or infinitely slow. No geologist will hesitate a moment to admit that the question between the schools is not one of geological result, for both read the results alike. I am sure no student of energy will object to my statement that the result requires identical energy, whether employed after the uniformitarian or the catastrophic method. If, as I assert, geological result and the energy to produce it are identical, whichever school is correct, then the only issue between the contestants reduces itself simply and solely to the one question of rate of geological change. In that view, uniformitarianism is the harmless, undestructive rate of to-day prolonged backward into the deep past. This is the belief hinted at by Aristotle and Pythagoras, fought for by Goethe, Lamarck, and Geoffroy St. Hilaire, held to by Hutton, Lyell, and most British geologists, accepted with a lover's credulity by nearly all evolutionists, and finally trumpeted about by the army of scientific fashion followers who would gladly die rather than be caught wearing an obsolete mode or believing in any penultimate thing.

On the other hand, catastrophism of the orthodox sort is the belief in recurrent, abrupt accelerations of geologic rate of crust change, so violent in their rapidity as to destroy all life on the globe. This idea, the mere survival of a prehistoric terror, backed up by breaks in the palæontological record and protected within those safe cities of refuge, the cosmogonies, was fully credited by so recent a great *savant* as Cuvier, and still counts among its soldiers a few of the cast-iron intellects of to-day.

Sweeping catastrophism is an error of the past. Radical uniformitarianism, however, persists, and probably controls the faith of a majority of geologists and biologists. A single extract from so late and so important a book as Croll's Climate and Time will serve to show how strong men still believe in what may be called homœopathic dynamics. Speaking of uniformitarianism, Croll says: "This philosophic school teaches, and that truly, that the great changes undergone by the earth's crust must have been produced, not by convulsions and cataclysms of nature, but by those ordinary agencies that we see at work every day around us, such as rain, snow, frost, ice, and chemical action, etc."

Having reduced the antagonism of the two schools to a question of rate of transference of energy, a single illustration will serve to render clear how, the amount of energy remaining the same, this difference of rate may make the difference between uniformity and catastrophe. Suppose two railway trains of equal weight, each traveling at the rate of fifty miles an hour. On one steam is suddenly shut from the cylinder. The train gradually lessens and lessens its speed, finally coming to rest. It has required a given definite amount of resistance, a numerically expressible amount of work to overcome the motion of the train. The other train at full speed dashes against a bridge pier and is utterly wrecked. The weight, speed, and momentum of the trains are identical, and precisely equal resistance has been expended in bringing them to a stop. In one case the rate of resistance was slow, and acted merely as friction, quite harmlessly to life and after the uniformitarian mode. In the other the rate of resistance was fatally rapid, and its result catastrophe.

Remembering distinctly that uniformitarianism claims one dynamic rate past and present, let us turn to the broader geological features of North America and try to unravel the past enough to test the tenets of the two schools by actual fact. Beneath our America lies buried another distinct continent, — an archæan America. Its original coast-lines we may never be

able fully to survey, but its great features, the lofty chains of the mountains which made its bones, were very nearly coextensive with our existing systems, the Appalachians and Cordilleras. The cañon-cutting rivers of the present Western mountains have dug out the peaks and flanks of those underlying, primeval uplifts and developed an astonishing topography: peaks rising in a single sweep thirty thousand feet from their bases, precipices lifting bold, solid fronts ten thousand feet into the air, and profound mountain valleys. The work of erosion which has been carried on by torrents of the Quaternary age — that is to say, within the human period — brings to light buried primeval chains far loftier than any of the present heights of the globe. Man's enthusiastic hand may clear away the shallow dust or rubbish from an Oriental city, and lay bare the stratified graves of perished communities: it is only a mountain torrent which can dig through thousands of feet of solid rock and let in the light of day on the time-stained features of a long-buried continent.

Archæan America was made up of what was originally ocean beds lifted into the air and locally crumpled into vast mountain chains, which were eroded by torrents into true subaerial mountain peaks. This conversion of sea strata into the early continent is the first record of a series of oscillations in which land and sea successively occupied the area of America. In pre-Cambrian time the continent we are considering sank, leaving some of its mountain tops as islands, and the neighboring oceans flowed over it, their bottoms emerging and becoming continents. This is the second of the recorded oscillations of the first magnitude.

After Archæ-America had began to sink and its bounding land masses to emerge, the conditions on the two sides of the ocean began to show characteristic difference of behavior, — difference in the rate of subsidence, — that very difference of rate which uniformitarianism denies.

Palæ-Pacifis and Palæ-Atlantis were land areas which I conceive to be of continental magnitude, from the vast volumes of sediment brought down by their rivers and poured into the Palæ-American Ocean. American geologists have found the record along the eastern margin of that ocean, namely, the present Appalachian region, so legible that they are agreed as to its main features. There is no plea of illegibility here. The total sediment which fringed the shore of Palæ-Atlantis was about forty-five thousand feet in maximum, but the original ocean, when strata began to gather, was not forty-five thousand feet deep.

That depth and the full accumulation of beds were arrived at by successive subsidences of the sea bottom. The Primordial or earliest Palæozoic along the eastern shore shows evidence of shallow water, which deepened by the occasional sinking of the sea floor. This periodic subsidence went on through the whole Palæozoic time, influencing the Appalachian region, and during the whole coal-bearing period affecting the sea bottom as far as Kansas. Shallow-water evidences are common up to the Carboniferous, after which successive low-level land areas repeatedly occupied the east half of the present Mississippi basin.

This immensely long history of periodic but general subsidence was broken in the northeast by several sudden uplifts, in which the sea strata were so disturbed and inclined that the succeeding beds rested on them, unconformably, and in one instance the Green Mountain range was upheaved. The general law on the east side of the Palæ-American Ocean has been the continual inpouring of sediment from Palæ-Atlantis, subsidence of sea bottom, repeated a great number of times, and only locally varied by dislocation and uplifts. A very limited but not unimportant chapter has just been added to the American rock record by the geological exploration of the fortieth parallel; it is the mode of deposition of the Palæozoic rock in the Western United States.

Passing now to the western side of the ocean, we have again the same enormous thickness of thirty or forty thousand feet of Palæozoic beds, but from bottom to top no evidence of disturbance, only uniform proof of deep oceanic deposition. In other words, the two sides differ: one went down by gradual and successive subsidence; the other at once sank so as to form a profound ocean, which, from beginning to end of the vast Palæozoic age, received in its quiet depth the dust of a continent and the débris of an ocean life. I do not say that the western ocean bottom never suffered further subsidence. I only assert that between the two sides the difference of rate was simply immense.

In keeping with the minor and slight movements of subsidence in the east are the changes in the materials of the gathering strata, which are found to vary continually. Here again the contrast between the east and west is marked. All the Palæozoic series in the west consist in the main of a few broad changes between quartzitic and limestone beds, both giving evidence of deep-sea deposition. By way of illustrating these changes of material, let us consider the condition of sedimentation at the west during the Carboniferous age. There we have seven thousand

feet of limestone, for the most part quite free from land-detritus, accumulated with all the evenness and regularity which the most ardent uniformitarian could ask, suddenly followed by an equal amount of pure land-detritus almost free from lime. This sudden change of sediment simply means a sudden physical change, either a cosmical one which recorded itself as a cycle of climate productive of great erosion, or a terrestrial change resulting in such great disturbance of distant land and sea areas as to cause new climate or new avenues of drainage, or some remote coast disturbance which brought about a revolution of oceanic currents. In either case the sudden change, both at the beginning and end of the quartzite period, and the vast scale of the deposit, means a change of rate in the current operation of nature, and an enormous change of rate. The abrupt passage from a period in which little or no land-detritus has entered a sea for millions of years to one when it pours in with relatively marvelous rapidity is certainly not uniformitarian. This phenomenon of sudden change in the broad petrographical features of a composite group of strata is equally true of each sudden break, of which the western Palæozoic has six. Recall that the bottom of all this ocean was a former continent, that along the east the continent went down gradually, by considerable steps it is true, but still by periodic and, perhaps, gradual subsidences. If the uniformitarians can derive any comfort from Eastern America, — and I suppose they justly may, — they are welcome to it. The rate of subsidence in the east, although not unlikely to have been catastrophic as regards the life of the disturbed region, looked at broadly may be called uniformitarian. That on the west was distinctly catastrophic in the widest dynamic sense.

Let us pass now to a remarkable chapter of events which closed the Palæozoic ages. What is now the eastern half of the Mississippi basin had through the coal period often extended itself as a land mass as far west as the Mississippi River, and had as often suffered subsidence and resubmergence. To the west, however, still stretched the open ocean, which, since the beginning of the Cambrian, had, with a single exception, never been invaded by land. At the close of the Palæozoic the two bordering land areas of Atlantis and Pacifis, since the beginning of the Cambrian permanent and perhaps extended continents, began to sink. They rapidly went down, and at last completely disappeared, their places being taken by the present Atlantic and Pacific oceans, while the sea floor of the American ocean, which had

been for the most part permanent oceanic area ever since the submergence of the archæan America, emerged and became the new continent of America, which has lasted with local vicissitudes up to the present. The east and west were, indeed, separated by a mediterranean sea, the sole relic of the American ocean, which now occupied a narrow north and south depression.

In that mediterranean sea, we may say that the conditions have been uniformitarian ; that is to say, in the great post-Palæozoic catastrophe that ocean was spared. It remained a body of deep water, its bottom undisturbed by folds or dislocations, and there is no evidence of a cessation of sediments ; yet the species which lived there throughout the vast length of the coal period were completely extinguished, and entirely new forms made their appearance. Although spared from the actual physical catastrophe, the effect of the general disturbance of that whole quarter of the globe was thoroughly catastrophic, and exerted a fatal influence upon life far beyond the actual theatre of upheaval.

Passing over the Mesozoic age, which in detail offers much instructive material as to rate of change, we pause only to notice a catastrophe which marked the close of that division of time.

In a quasi-uniformitarian way, 20,000 or 30,000 feet of sediment had accumulated in the Pacific and 14,000 in the mediterranean sea, when these regions, which, during their reception of sediment, had been areas of subsidence, suddenly upheaved, the doming up of the middle of the continent quite obliterating the mediterranean sea and uniting the two land masses into one.

The catastrophe which removed this sea resulted in the folding up of mountain ranges 20,000 and 40,000 feet in height, thereby essentially changing the whole climate of the continent. Of the land life of the Mesozoic age we have abundant remains. Thanks to the palæontologists, the wonderful reptilian and avian fauna of the Mesozoic age is now familiar to us all. But after the catastrophe and the change of climate which must necessarily have ensued, this fauna totally perished. The rate of this post-Cretaceous change was, in other words, catastrophic.

During the Tertiary, fresh-water lakes of wide extent occupied the western half of the continent. Such was the character of the great post-Cretaceous uplift that there were left broad, deep continental basins above the level of the sea. Into these the early Tertiary rivers found their way, creating extended lakes in which accumulated strata rivaling in importance the deposits

of the great oceans. The whole history of the Tertiary is that of the accumulation of thick sedimentary series in fresh-water lakes, accompanied by gradual and periodic subsidence, carried on smoothly and uniformly up to a certain point, and then interrupted by a sudden, mountain-building upheaval, which drained the lakes and created new basins. The five minor catastrophes which have taken place in the western half of America during the Tertiary age have never resulted in those broader changes which mark the close of the Archæan, the Palæozoic, and the Mesozoic ages. They never broke the grander outline of the continent. They were, however, of such an important scale as to very greatly vary the conditions of half the continent. I may cite the latest important movement, which took place probably within the human epoch, certainly at the close of the great Pliocene lake period of the west. The whole region of the great plains, as far north as we are acquainted with their geology, and southward to the borders of the Gulf, was occupied by a broad lake which existed through the Pliocene period, having always a subtropical climate. In that lake, beds 1000 to 1200 feet thick had accumulated, when suddenly the level floor was tilted, causing a difference of height of 7000 feet between the south and west shores, making the great inclined surface of the present plains, and utterly changing the climate of the whole region. Not a species survived.

I have thus hastily mentioned a few of the most important geological crust changes in America whose rates are demonstrably catastrophic. Besides surface changes involving subsidence, upheaval, faulting, and corrugation, all of which may be executed on a scale or at a rate productive of destruction of life, catastrophes may be brought about by sudden great changes of climate or by intense volcanic energy. In the latter field there are obviously no catastrophes of the first order. Geological maps of the globe have progressed far enough to demonstrate that considerable areas are, and always have been, free from actual ejection of volcanic materials. On the contrary, numerous great regions, notably the western third of our own continent and the shores of the Pacific, were once literally deluged with volcanic fires. An examination of the ejected rock shows that modern eruptions, by which the volcanic cones of the present period are slowly built up from slight overflows piling one upon another, are not the method of the great Miocene and Pliocene volcanic periods. There were then outbursts hundreds of miles in extent, in

which the crust yawned and enormous volumes of lava rolled out, overwhelming neighboring lands. Volcanoes proper are only isolated chimneys, imposing indeed, but insignificant when compared with the gulfs of molten matter which were thrown up in the great massive eruptions. Between the past and present volcanic phenomena there is not only a difference of degree but of kind. It is easy to read the mild exhibition of existing volcanoes as a uniformitarian operation, namely, the growth of cones by slight accretions; but such reasoning is positively forbidden in the past.

If poor, puny little Vesuvius could immortalize itself by burying the towns at its feet, if the feeble energy of a Lisbon earthquake could record itself on the grave-stones of thousands of men, then the volcanic period in Western America was truly catastrophic. Modern vulcanism is but the faint, flickering survival of what was once a world-wide and immense exhibition of telluric energy, one whose distortions and dislocations of the crust, whose deluges of molten stone, emissions of mineral dust, heated waters, and noxious gases could not have failed to exert destructive effect on the life of considerable portions of the globe. It cannot be explained away upon any theory of slow, gradual action. The simple field facts are ample proof of the intensity and suddenness of Tertiary vulcanism.

Of climate catastrophes we have the record of at least one. When the theory of a glacial period came to be generally accepted, and the destructive effects of the invasion of even middle latitudes by polar ice were realized, especially when the devastating effects of the floods which were characteristic of the recession of the ice came to be studied, uniformitarianism pure and simple received a fatal blow. I am aware that British students believe themselves justified in taking uniformitarian views of the bowlder-till, but they have yet to encounter phenomena of the scale of our Quaternary exhibitions.

A most interesting comparison of the character and rate of stream erosion may be obtained by studying in the western Cordilleras, the river work of three distinct periods. The geologist there finds preserved and wonderfully well exposed, first, Pliocene Tertiary river valleys, with their bowlders, gravels, and sands still lying undisturbed in the ancient beds; secondly, the system of profound cañons, from 2000 to 5000 feet deep, which score the flanks of the great mountain chains, and form such a fascinating object of study, and not less of wonder, because the

gorges were altogether carved out since the beginning of the glacial period; thirdly, the modern rivers, mere echoes of their parent streams of the early Quaternary age. As between these three, the early Quaternary rivers stand out vastly the most powerful and extensive. The present rivers are utterly incapable, with infinite time, to perform the work of glacial torrents. So, too, the Pliocene streams, although of very great volume, were powerless to wear their way down into solid rock thousands of feet, at the rapid rate of the early Quaternary floods. Between these three systems of rivers is all the difference which separates a modern (uniformitarian) stream and a terrible catastrophic engine, the expression of a climate in which struggle for existence must have been something absolutely inconceivable when considered from the water precipitations, floods, torrents, and erosions of to-day.

Uniformitarians are fond of saying that give our present rivers time, plenty of time, and they can perform the feats of the past. It is mere nonsense in the case of the cañons of the Cordilleras. They could never have been carved by the pigmy rivers of this climate to the end of infinite time. And, as if the sections and profiles of the cañons were not enough to convince the most skeptical student, there are left hundreds of dry river-beds, within whose broad valleys, flanked by old steep banks and eloquent with proofs of once-powerful streams, there is not water enough to quench the thirst even of a uniformitarian. Those extinct rivers, dead from drought, in connection with the great cañon system, present perfectly overwhelming evidence that the general deposition of aerial water, the consequent floods and torrents, forming as they all do the distinct expression of a sharply-defined cycle of climate, as compared either with the water phenomena of the immediately preceding Pliocene age or with our own succeeding condition, constitute an age of water catastrophe whose destructive power we only now begin distantly to suspect.

I have given you what in my belief are sound geological conclusions, the want of time alone causing me to waive the slow production of proofs. I believe I am fully prepared to sustain the assertions, first, that the rate of physical change progressing to-day in all departments of terrestrial action is inadequate to produce the grander features of American geological history; secondly, that in the past, at intervals, the dynamic rate has been so sharply accelerated as to bring about exceptional results; thirdly, that these results have been catastrophic in their effect

upon the life of America and the bounding oceans. I have called the revolutions in the American area catastrophic because any disturbances of land or sea, of the described scale, intensity, and rapidity, could not fail to have a disastrous effect on much of the organic world. The uniformitarian school would accept these crust changes with unruffled calmness ; they would read the record exactly as a catastrophist might, only they would assume unlimited time and their inch-by-inch process. The analogy of the present, they say, is against any acceleration of rate in the past, and besides, the geological record is a very imperfect document which does not disprove our view. In plain language, they start with a gratuitous assumption (vast time), fortify it by an analogy of unknown relevancy (the present rate), and serenely appeal to the absence of evidence against them as proof in their favor. The courage of opinion has rarely exceeded this specimen of logic. If such a piece of reasoning were uttered from a pulpit against evolution, biology would at once take to her favorite sport of knuckle-rapping the clergy in the manner we are all of us accustomed to witness. In forbidding us to look for past rates of change differing from the present, the British uniformitarians have tied the hands of the science. By preaching so eternally from the text of "imperfection of the geological record," they have put blinders on the profession. A few more such doctrines will reduce the science to a corpse, around which teleologists and biologists might hold any sort of funeral dance their fancy dictated. Now, because the record is not altogether made out is no proof whatever that it never will be. There was once a discovery of a very small piece of evidence, the Rosetta Stone, which served as a key to a vast amount of previously illegible material. Geology, if not strangled in its own house, will, in my belief, go on and dig up enough Rosetta Stones to translate the strata into a precise language of energy and time.

As yet we have no means, beyond mere homotaxial comparison, for relating the crust movement of distant regions. I do not, however, despair of our being able to correlate the movements and revolutions of different continents. At present, old-fashioned catastrophes, involving repeated world-wide destruction of all life, such cataclysms as Cuvier believed in, and which occasioned the revolt of the biologists of his time, are justly repudiated. On the other hand, the mild affirmations of the uniformitarians, that existing rates of change and indefinite time

are ample to account for the past, are flatly and emphatically contradicted by American facts. With our present light, geological history seems to be a dovetailing together of the two ideas. The ages have had their periods of geological serenity, when change progressed in the still, unnoticeable way, and life through vast lapses of time followed the stately flow of years, drifting on by insensible gradations through higher and higher forms, and then all at once a part of the earth suffered short, sharp, destructive revolution, as unheralded as an earthquake or volcanic eruptions. The sciences are as independent as bodily organs; they are the vitals of human knowledge. A fallacy lodged in one produces functional disturbance of the others. It was the error of universal and extreme catastrophes which so violated the conceptions of Lamarck, Goethe, and St. Hilaire as to draw out their earnest protest, and as usual they urged the pendulum past the golden mean of truth over to the counter error of extreme uniformitarianism. This later error has been confidently built in as one of the corner-stones of the imposing structure of evolution. I believe the crumbling, valueless nature of this foundation will yet make itself felt in the ruin of just so much as the builders have rested upon it.

If the vicissitudes of our planet have been as marked by catastrophes as I believe, how does that law affect our conceptions of the development of life and the hypothesis of evolution? Man, whatever the drift of life or philosophy, returns with restless eagerness, with pathetic anxiety, to the enigma of his own origin, his own nature, his own destiny. With reverence, with levity, with faith, with doubt, with courage, with cowardice, by every avenue of approach, in every age, the same old problem is confronted. We pour out our passionate questionings, and hearken lest mute nature may this time answer. But nature yields only one syllable of reply at a time.

Darwin, who in his day has caught the one syllable from nature's lips, advances always with caution, and although he practically rejects does not positively deny the existence of sudden great changes in the earth's history. Huxley, permeated in every fibre by belief in evolution, feels that even to-day catastrophism is not yet wholly out of the possibilities. It is only lesser men who bang all the doors, shut out all doubts, and flaunt their little sign, "Omniscience on draught here." It must be said, however, that biology, as a whole, denies catastrophism in order to save evolution. It is the common mistake of biologists to as-

sume that catastrophes rest for their proof on breaks in the palæontological record, meaning by that the observed gaps of life or the absence of connecting links of fossils between older and newer sets of successive strata. There never was a more serious error. Catastrophes are far more surely proved by the observed mechanical rupture, displacement, engulfment, crumpling, and crushing of the rocky surface of the globe. Granted that the evidence would have been slightly less perfect had there been no life till the present period, still the reading would have been amply conclusive. The palæontological record is as imperfect as Darwin pleads, but the dynamic record is vitiated by no such ambiguity.

It is the business of geology to work out the changes of the past configuration of the globe and its climate; to produce a series of maps of the successive stages of the continents and ocean basins, but it is also its business to investigate and fix the rates of change. Geology is not solely a science of ancient configuration. It is also a history of the varying rates and mode of action of terrestrial energy. The development of inorganic environment can and must be solved regardless of biology. It must be based on sound physical principles, and established by irrefragable proof. The evolution of environment, a distinct branch of geology which must soon take form, will, I do not hesitate to assert, be found to depend on a few broad laws, and neither the uniformitarianism of Lyell and Hutton, Darwin and Haeckel, nor the universal catastrophism of Cuvier and the majority of teleologists, will be numbered among these laws. In the dominant philosophy of the modern biologist there is no admission of a middle ground between these two theories, which I, for one, am led to reject. Huxley alone, among prominent evolutionists, opens the door for union of the residua of truth in the two schools, fusing them in his proposed evolutional geology. Looking back over a trail of thirty thousand miles of geological travel, and after as close a research as I am capable, I am impelled to say that his far-sighted view precisely satisfies my interpretation of the broad facts of the American continent.

The admission of even modified catastrophe, namely, suddenly-destructive, but not all-destructive change, is, of course, a downright rejection of strict uniformitarianism. I comprehend the importance of the position, how far-reaching and radical the logical consequences of this belief must be. If true, it is nothing less than an ignited bomb-shell thrown into the camp of

the biologists, who have tranquilly built upon uniformitarianism, and the supposed imperfection of the geological record. I quote a few of their characteristic utterances. Lamarck, in his Philosophie Geologique, 1809, says, "The kinds or species of organisms are of unequal age, developed one after another, and show only a relative and temporary persistence. Species arise out of varieties. . . . In the first beginning only the very simplest and lowest animals and plants came into existence; those of a more complex organization only at a later period. The course of the earth's development and that of its organic inhabitants was continuous, not interrupted by violent revolutions. . . . The simplest animals and the simplest plants, which stand at the lowest point in the scale of organization, have originated and still originate by spontaneous generation." Darwin[1] says: "We must be cautious in attempting to correlate as strictly contemporaneous two formations, which include few identical species, by the general succession of their forms of life. As species are produced and exterminated by slowly acting and still acting causes, and not by miraculous acts of creation and by catastrophes. . . . And again, for my part, following out Lyell's metaphor, I look at the natural geological record as a history of the world imperfectly, kept and written in a changing dialect; of this history we possess the last volume alone, relating only to two or three countries. Of this volume, only here and there a short chapter has been preserved; and of each page only here and there a few lines. Each word of the slowly changing language in which the history is written, being more or less different in the successive chapters, may represent the apparently abruptly changed forms of life entombed in our consecutive but widely separated formations. On this view, the difficulties above discussed are greatly diminished, or even disappear."

It is unnecessary to repeat here the well-known views of Lyell. How far biologists have learned to lean on his uniformitarian conclusions may be seen from the following quotation from Haeckel,[2] "He [Lyell] demonstrated that those changes of the earth's surface which are still taking place before our eyes are perfectly sufficient to explain everything we know of the development of the earth's crust in general, and that it is superfluous and useless to seek for mysterious causes in inexplicable revolutions. He showed that we need only have recourse to the hypothesis of

[1] Origin of Species, p. 522.

[2] History of Creation, vol. i., pages 127–129.

exceedingly long periods of time, in order to explain the formation of the crust of the earth in the simplest and most natural manner, by the means of the very same causes which are still active. Many geologists had previously imagined that the highest chains of mountains which rise on the surface of the earth could owe their origin only to enormous revolutions transforming a great part of the earth's surface, especially to colossal volcanic eruptions. Such chains of mountains as those of the Alps or the Cordilleras were believed to have arisen direct from the fiery fluid of the interior of the earth through an enormous chasm in the broken crust. Lyell, on the other hand, showed that we can explain the formation of such enormous chains of mountains quite naturally by the same slow and imperceptible risings and depressions of the earth's surface which are still continually taking place, and the causes of which are by no means miraculous. Although these depressions and risings may perhaps amount only to a few inches, or at most a few feet, in the course of a century, still in the course of some millions of years they are perfectly sufficient to raise up the highest chains of mountains without the aid of mysterious and incomprehensible revolutions. . . . We have long known, even from the structure of the stratified crust of the earth alone, that its origin and the formation of neptunic rocks from water must have taken at least several millions of years. From a strictly philosophical point of view, it makes no difference whether we hypothetically assume for this process ten millions or ten thousand billions of years. Before us and behind us lies eternity." This is even bolder than Hutton, who says: "I take things as I find them at present; and from these I reason as regards that which must have been. . . . A theory, therefore, which is limited to the actual constitution of this earth, cannot be allowed to proceed one step beyond the present order of things."

The successive hypotheses which, linked together, form the chain of evolution are, first, the nebular hypothesis; second, spontaneous generation; third, natural selection. It is only with the last that geology has intimate relation. The general theory of a derivative genesis or the descent of all organisms by the various modes of reproduction from one or a few primitive types which came into existence by spontaneous generation was believed long before the Darwinian theory was advanced. Darwin's great contribution was the modus operandi of derivative genesis. It was a mode of accounting for the in-

finite branching out and differentiation of the complex forms of life from the primitive germs. His theory is natural selection, or the survival of the fittest, a doctrine which, left where Darwin leaves it, has its very roots in uniformitarianism.

Analyzed into its component parts, natural selection resolves, as is well known, into two laws, hereditivity and adaptivity: first, the power on the part of organisms to transmit to offspring their own complex structure down to the minutest details; and, secondly, the power by slight alterations on the part of all individuals to vary slightly in order to bring themselves into harmony with a changed environment. When we bring geology into contact with Darwinism, it is evident that hereditivity is out of the domain of our inquiry; it is not the engine of change, it is the conservator of the past; but the companion law of adaptivity, or the accommodation to circumstances, is one which depends half upon the organism and half upon the environment; half upon the vital interior, half upon the pressure which the environment brings to bear upon it. Now, environment, as conclusively shown by biologists, is a twofold thing, a series of complicated relationships with contemporaneous life, but, besides, with the general inorganic surrounding, involving climate and position upon the globe. Preoccupied with the strictly biological environment, namely, the intricate relation of dependence of any species upon some of its surrounding species, biologists have signally failed to study the power and influence of the inorganic or geologic environment. The actual limits of the influence of physical conditions on life are practically unknown. In America more than in Europe this branch of inquiry has begun to attract notice, but it is yet in its swaddling-clothes. It has lain little and weak from inanition, while the favorite child, Natural Selection, has been fed into a plethoric, overgrown monster. Darwin, Wallace, Haeckel, and the other devoted students of natural selection have brought to light the most astonishingly complex struggle for existence, everywhere progressing — the fiercest battle for life and for subsistence, for standing-room, for breath. Some species gain, others lose, some go down to annihilation. In this battle they seea dequate cause for all the great, highly organized products of the millions of years since life began. From their logic, you and I are conquerors who have mounted to manhood by treading out the life of infinite generations. We are what we are because this brain and this body form the most effective fighting-machine the dice-box of ages has thrown.

From their conclusions and philosophy let us turn, but with no revolt of prejudice, no rebound of a happier intuition, for this is a question of science. Those who defend the stronghold of natural selection are impregnable to the assaults of feeling. They are dislodged only by the solid projectiles of fact, and to facts cast in the mold of nature they count it no dishonor to surrender. If, as I have said, the evolution and power of environment have been singularly neglected studies, if biologists have allowed the splendor of their achievements within the province of life to blind them to the working of that other and no less important side of the problem, what then is the general relation in time and space of the inorganic environment to life?

Let us first acknowledge frankly that the present and later parts of the Quaternary period are uniformitarian; that the changes going on in organic life now do obey the great law of survival of the fittest, and that if the uniformitarians were true in making of the past a mere infinite projection of the present, then the biologists would have based their theories on a solid foundation, and my protest would have no weight. Let us go further and cordially admit that in all periods of uniformity the progress of life would adjust itself to its surroundings, and the war of competitive extermination become the dominant engine of change and development. This is giving full credit to the greatness of the biological result, and simply asserts that they who achieved it are sound as far as the analogy of present uniformity may be permitted to go. But uniformity has not been the sole law; it has, as we have seen, been often broken by catastrophes, — that is, by accelerated rate of change. Rapid physical change has been, it seems to me, the more important of the two conditions of the past, the one whose influence will at last prove to have been the dominant one in life change.

Has environment, with all the catastrophic changes, been merely passive as regards life? It has either had no effect, or has restrained the progress of evolution, or has advanced it, or its influence has been as varied as its own history, — now by the development of favoring conditions accelerating vital progress, now suddenly exterminating on a vast scale, again urging evolution forward, again leaving lapses of calm in which species took the matter into their own hands and worked out their own destiny. It is only through rapid movements of the crusts and sudden climatic changes, due either to terrestrial or cosmical causes, that environment can have seriously interfered with the evolution of

life. These effects would, I conceive be, first, extermination; secondly, destruction of the biological equilibrium, thus violating natural selection; and thirdly, rapid morphological change on the part of plastic species. When catastrophic change burst in upon the ages of uniformity, and sounded in the ear of every living thing the words "change or die," plasticity became the sole principle of salvation. Plasticity, then, is that quality which, in suddenly enforced physical change, is the key to survival and prosperity. And the survival of the plastic, that is of the rapidly and healthily modifiable during periods when terrestrial revolution offers to species the rigorous dilemma of prodigious change or certain death, is a widely different principle from the survival of the fittest in a general biological battle during terrestrial uniformity. In one case it is an accommodation between the individual organism and inorganic environment, in which the most yielding and plastic lives. In the other it is a Malthusian death struggle, in which only the victor survives. At the end of a period of uniformitarian conditions, the Malthusian conqueror, being the fittest, would have won the prize of survival and ascendency. Suppose now an interval of accelerated change. At the end only the most plastic would have deviated from their late forms and reached the point of successful adaptation, which is survival in health. Whatever change takes place by natural selection in uniformitarian ages, according to Darwin, advances by spontaneous, aimless sporting and the survival of those varieties best adapted to surrounding conditions, and of these conditions the biological relations are by far the most important of all. By that means, and by that alone, it is asserted, species came into existence, and inferentially all the other forms from first to last. This is the gospel of chance.

If the out-door facts of American geology shall be admitted to bear me out in my assertion of catastrophes, and if the epochs of maximum vital change do, as I hold, coincide with the epochs of catastrophes, then that coincidence should be directly determinable in the field. I confidently assert that no American geologist will be able to disprove the law that in the past every one of the great breaks in the column of life coincide with datum points of catastrophe. It remains to be determined how far this coincidence is the expression of environmental cause, responded to in terms of vital effect.

From a comparison of the list and character of geological changes in America with those mysterious lines across which no

species march, I feel warranted in harboring the belief that catastrophe was an integral part of the cause ; changed life, the effect. Biologists are accustomed to explain the cause of a great gap like that which divides the Palæozoic and Mesozoic life by an admission that the Palæozoic forms ceased to live, but that the succeeding changed forms at the beginning of the Mesozoic were not the local progeny, greatly modified by catastrophic change, but merely immigrants from some other conveniently assumed country. They succeed in rendering this highly probable, if not certain, in many instances. But they are estopped from always advancing this migration theory. Greek art was fond of decorating the friezes of its sacred edifices with the spirited form of the horse. Times change; around the new temple of evolution the proudest ornament is that strange procession of fossil horse skeletons, among whose captivating splint-bones and general anatomy may be descried the profiles of Huxley and Marsh. Those two authorities, whose knowledge we may not dispute, assert that the American genealogy of the horse is the most perfect demonstrative proof of derivative genesis ever presented. Descent they consider proved, but the fossil jaws are utterly silent as to what the cause of the evolution may have been.

I have studied the country from which these bones came, and am able to make this suggestive geological commentary. Between each two successive forms of the horse there was a catastrophe which seriously altered the climate and configuration of the whole region in which these animals lived. Huxley and Marsh assert that the bones prove descent. My own work proves that each new modification succeeded a catastrophe. And the almost universality of such coincidences is to my mind warrant for the anticipation that not very far in the future it may be seen that the evolution of environment has been the major cause of the evolution of life; that a mere Malthusian struggle was not the author and finisher of evolution ; but that He who brought to bear that mysterious energy we call life upon primeval matter bestowed at the same time a power of development by change, arranging that the interaction of energy and matter which make up environment should, from time to time, burst in upon the current of life and sweep it onward and upward to ever higher and better manifestations. Moments of great catastrophe, thus translated into the language of life, become moments of creation, when out of plastic organisms something newer and nobler is called into being.

## ON CHANGES OF HABIT AMONG WOODPECKERS.[1]

BY SAMUEL CALVIN.

IT has long been known to naturalists that certain genera of woodpeckers have wholly or partly adopted habits quite inconsistent with those generally suggested when we think of the group.

Within the past two or three years I have frequently had the pleasure of observing the red-headed woodpecker in the act of catching flies on the wing. Seating itself on the summit — not on the side — of some fence-stake or other elevated perch, it watches, as does the kingbird, for passing insects. Having singled out the desired victim from among many not worth catching, it darts forward, catches it, and returns, usually to the same perch, to wait for the next. This any one may see repeated over and over again by the same individual, showing that it is no mere chance departure from woodpeckerian dignity into which the bird is inadvertently betrayed, but is rather one of the ordinary and settled practices resorted to in procuring food.

The movements in the air of this woodpecker are very similar to those of the kingbird; it executes the gyrations and peculiar gymnastics necessary to follow the dodging insect with great adroitness.

What is the meaning of all this? The barbed tongue, stout, straight bill, muscular neck, and structural adaptations for climbing, all point to a different mode of life. None of them, certainly, can be regarded as rendering the bird any special fitness for fly-catching. It must be that the struggle for life among bark-searching birds has recently — within the past two or three geological epochs — become more severe, so much so as to drive some of them to the adoption of other habits, quite regardless of structural fitness. The golden-winged woodpecker (*Colaptes auratus*), as all know, has been driven from the trees to feed largely on the ground. Its near relative (*Colaptes campestris*), of some parts of South America, frequents open plains, and, according to the testimony of competent observers, is never seen on trees at all.

As bearing upon these changes of habit, and perhaps furnishing a suggestion in part of their compelling cause, it is interesting to note that quite a number of the perching birds have settled into the questionable habit of systematically poaching upon the special domain of the woodpecker. Among the war-

[1] Read before the Iowa Academy of Science, May 3, 1877.

blers, even, we have in Iowa the black and white creeper (*Mniotilta varia*), that excels most woodpeckers in ability to scramble over and thoroughly search the bark of a tree. The whole family of creepers, the Certhias, — represented with us by the little brown creeper, (*Certhia familiaris*), — is also able to compete successfully with woodpeckers on their own ground. But perhaps the most expert of all the perchers that have taken to clambering over trees are the nut-hatches. A very common one is the *Sitta Carolinensis*, which may be seen almost any day on trees in our streets and door-yards. Its nervous and rapid movements, its slaty-colored back, and black crown must be familiar to all. It moves upward and downward with equal facility and always head foremost; the upper and under side of a limb are explored with equal ease; rarely resting, it frisks up and down, round and round, over and under, in and out, finishing a tree and ready for the next long before the average woodpecker would be able to collect himself and get fairly under way.

The habit of climbing is certainly an ancient one among woodpeckers. All the genera have the feet, tongue, bill, tail feathers, etc., modified in substantially the same way, and this would point to an ancestor that practiced their characteristic habits before the modern genera began to diverge. On the other hand, we may fairly conclude that since climbing is rather exceptional among perchers, the few groups that practice it have acquired it at a comparatively recent date, and it is quite possible that competition with climbing perchers may constitute a large share of the disturbing cause which has compelled certain woodpeckers of late to abandon the habits of their ancestors.

It is worthy of note, too, that the species which have suffered most in this competition are among the largest of our Northern woodpeckers. With the exception of the pileated woodpecker, they are in fact the largest, and furnish another illustration of the fact that nature looks with but small favor upon mere bulk. A little nerve often outweighs a large amount of muscle.

The pileated woodpecker frequents deep forests, and I have never been able to observe its habits. Its retirement, however, has withdrawn it from competition with the more agile forms we have noticed, and if food is only sufficiently abundant there is no immediate necessity for giving up its ancestral habits. The redhead and flicker, preferring open glades, are brought into constant and active competition with more sprightly and energetic climbers, and find themselves obliged to adopt other habits in great measure, or perish.

# ABORIGINAL SHELL ORNAMENTS, AND MR. F. A. BARBER'S PAPER THEREON.

BY R. E. C. STEARNS.

IN the May number of the AMERICAN NATURALIST (page 271) Mr. E. A. Barber, in an article on Stone Implements and Ornaments from the Ruins of Colorado, Utah, and Arizona, remarks: "The marine shells which were converted into beads by the ancient tribes, so far as ascertained by the investigations of the United States Geological Survey, during the summer of 1875, were the *Oliva* and (possibly) the *Busycon* or *Murex*. . . . Figure 7, Plate I., represents a specimen of the *Oliva biplicata* (probably), although the shell is so weather worn that the specific characteristics are almost entirely obliterated. Still it strongly resembles this species of the Pacific coast, and is very likely the same." In a foot-note Mr. Barber says that "it may be *Olivella gracilis*."

The figure referred to certainly *does not* strongly resemble *O. biplicata*, and if reasonably accurate, the specimen from which the figure was drawn does not belong to the said species. It may be either *O. gracilis* or *O. dama*,[1] common Gulf of California forms, not found as yet north of latitude 25° N. on the ocean side of Lower California, or it way be *O. bœtica*, which like *O. biplicata* is a northern species, not found in the Gulf.

There is no species of *Busycon* on the Pacific Coast, and *Murex*,[2] though found in the Gulf, seldom occurs on the outer shore north of Cape St. Lucas, and is rare at the cape. "*Murex*" as used here is exceedingly vague, for the *Muricidæ* are so largely represented upon this part of the West American or more exactly West Mexican coast, and includes so many well-marked groups, that the name of the genus, subgenus, or group should be given.

The importance of an accurate determination of species of shells, in connection with the "ancient tribes" of the region named in Mr. Barber's paper, and as related under similar conditions to ethnological questions, ppon a brief review of the points involved, will be seen at a glance.

If the beads or ornaments were made of the shells of *Murex* and *Olivella*, either *O. gracilis* or *O. dama*, Gulf forms, it in-

[1] Cooper in Geog. Cat., sp. 732, credits San Pedro, Cal., with this form, but it has not been verified.

[2] Whether Murex proper or the markedly prominent group, *Phyllonotus*, is not stated by Mr. Barber.

dicates a line of communication, intercourse, traffic, and possibly migration by the way of the Gulf of California and the Colorado River. If the Olivella is *O. biplicata*, and the beads, which it is said are as thin as a wafer and of the circumference of an ordinary pea, are what I suspect,[1] then we have a right to infer that these interior people were in communication directly or indirectly with the California tribes north of what is now known as Lower California. If any of the shell ornaments are made of some species of *Busycon*, then communication with the Gulf of Mexico is implied.

If all of the shells cited by Mr. Barber, and involved in doubt by the indefiniteness of his paper, are actually represented in the material collected, then the whole question as to the origin, distribution, and characteristics of the extinct tribes of Colorado, Utah, and Arizona is still further complicated, for it indicates intercourse, traffic, and perhaps migration in three directions, and the relations of these interior people with the maritime or coast tribes of both sides of the continent, or through, or with intermediate tribes, become a factor which has to be duly weighed and considered, the importance of which is only equaled by its complexity.

It is highly probable that an examination of the shell ornaments mentioned by Mr. Barber by some competent conchologist familiar with West American shells and with the ethnological material of the California mounds would authenticate the species of which Mr. Barber's shell ornaments are made, and it is to be hoped that he will have them carefully examined, and state not only the species but the authority for their determination. By doing so he will add much to the value of his researches, and the object of this criticism will be accomplished.

## THE LONG-JAWED GOBY.

BY W. N. LOCKINGTON.

THE somewhat inelegant title I have given to this curious little fish cannot be said to be its vernacular name, since, like the greater portion of the creatures that inhabit the world, it has not as yet acquired a commonly received name in our language, and the only name it has a perfect right to is the Latin one bestowed by its first describer, Dr. J. G. Cooper, namely, *Gillichthys mirabilis*.

[1] Similar beads are found in the California mounds, and are simple concavo-convex disks cut out of the body whorl of *O. biplicata*.

As *Gillichthys* is simply a compound of the name of a celebrated American icthyologist with the Greek word for a fish, and *mirabilis* means nothing more than "wonderful" or "curious," this Latin name gives no idea of the fish, so it will be as well to call it the long-jawed goby, as its chief peculiarity consists in its tremendous length of jaw.

A garpike has a long jaw, and so has an alligator, and it is not unlikely that the title will call up in the minds of some who read this the idea of a terrible mouth, armed with bristling rows of teeth. This would be a great mistake, for our little fish has no teeth worth bragging about, and does not open his mouth any wider than a well-behaved fish should do. The great difference between his long jaws and those of a garpike is that the latter's project forwards, while those of our goby are prolonged backwards immensely.

The long-jawed goby was discovered by Dr. Cooper in the bay of San Diego, among seaweed growing on small stones at the wharf, and in such a position that it must have been out of water from three to six hours daily, though kept moist by the seaweed.

Dr. Cooper's two specimens held their place as curiosities among the *olla podrida* of the Museum of the California Academy of Sciences for several years, no one suspecting that the fish was a resident of the neighborhood of San Francisco, as no specimens were ever found in the fish-market.

A few months ago two specimens were brought to the Academy by one of its members, who stated that he had obtained them from some Chinamen who lived on the marshes near the mouth of San Antonio Creek, Oakland; that they were found by digging in the mud beside the brackish creeks that intersect the marshes, and that the Chinamen eat them, and find them good.

These specimens were not so large as those presented by Dr. Cooper, and differed from them in the much smaller proportionate length and width of the singular cartilaginous expansion of the maxillary bone, which, uniting with a membrane from the lower jaw, continues backwards as a long fold or pouch as far as, or even beyond, the gill-covers, and gives to the fish its unique appearance.

On a more recent occasion a single *Gillichthys*, much larger than any of those before mentioned, was presented by a gentleman, who said that the fish, which was new to him, was abundant upon his ranch in Richardson's Bay, in the northern part of the bay of San Francisco; that the Chinamen dug them up and

ate them, and that he had had about eleven specimens cooked, and found them good, tasting, he thought, something like eels, the twelfth specimen he had preserved in alcohol, in the interest of natural science. This gentleman had the opportunity of observing something of the mode of life of these fishes, and informed us that their holes, excavated in the muddy banks of tidal creeks, increase in size as they go downwards, so that the lower portion is below the water level, or at least sufficiently low to be kept wet by the percolation from the surrounding mud.

When the various specimens now acquired were placed side by side, the difference in the relative length of their jaws was very conspicuous, for while in the smallest it was about one-fifth of the total length, in the largest it exceeded one-third.

As the fish had now been found in two places in the bay, I thought I would try to find it also, and to this end sallied out one morning, armed with a spade, and commenced prospecting in a marsh at Berkeley, not very far from the State University. For a long time I was unsuccessful, as I did not know by what outward signs their habitations could be distinguished, and the extent of mud-bank left bare by the retreating tide, was, as compared with my powers of delving, practically limitless.

At last, toward evening, while digging in the bend of a small creek, in a stratum of soft, bluish mud, and at a depth of about a foot below a small puddle, I found five small fishes, which at first I believed to belong to an undescribed species, so little did they resemble the typical *G. mirabilis*, but which proved, upon a closer examination, to be the young of that species. There was the depressed, broad head, the funnel-shaped ventral "disk" formed by the union of the two ventral fins, and the compressed tail of the long-jawed goby, but where were the long jaws? The jaws were, of course, in their usual place, but their prolongations had only just commenced to grow along the sides of the head, and were not noticeable unless looked for. A comparison of the various specimens proved conclusively that the strange-looking appendage is developed during the growth of the fish, as will be seen by the following measurements of four individuals: —

| | No. 1. | No 2. | No. 3. | No. 4. |
|---|---|---|---|---|
| Total length | 65 mm. | 98 mm. | 132 mm. | 165 mm. |
| From tip of snout to end of maxillary expansion, measured along curve to centre line of jaw. | 11 mm. | 20 mm. | 40 mm. | 56 mm. |

In the smallest specimen the maxillary expansion extends beyond the orbit for a distance about equal to that which inter-

venes between the anterior margin of the orbit and the tip of the snout; in No. 2 it reaches to the posterior margin of the preoperculum; in No. 3 it ends level with the gill-opening; while in the largest individual it passes the origin of the pectoral and ventral fins.

What can be the use of this long fold of skin and cartilage, which is not attached to the head except where it joins the mouth; and which from its gradual development and ultimate large dimensions, must certainly serve some useful purpose?

Do not understand that I mean that every part of a creature is of use to it in its present mode of life, for as all naturalists know, there are in structural anatomy, just as in social life, cases of *survival;* remains of organs which were at some former time more developed, parallel in their nature to such survivals in costume, as the two buttons on the back of a man's coat, once useful for the attachment of a sword-belt. But in this fish we have no case of survival, but one of unusual development; the family (Gobiidæ) to which it belongs presents no similar case, although its members have somewhat similar habits, and the conviction grows upon us, as we consider the subject, that the long jaws serve some useful purpose in the economy of the creature. In view of the half-terrestrial life led by this fish, I am inclined to suspect that the expansion of the upper jaw may serve for the retention of a small quantity of water, which, slowly trickling downward into the mouth and gills, keeps the latter moist when, from an unusually low tide or a dry season, the waters of its native creek fail, perhaps for several hours, to reach the holes in which the fishes dwell. It may be objected to this view that, were such an appendage necessary, or even useful, other species of Gobiidæ, whose habits are similar, would show traces of a similar adaptation. This, however, by no means follows. Nature has many ways of working out the same end; and it must be remembered that every real species when thoroughly known differs somewhat in habits from its congeners, or at least from its family friends. To take an illustration from the mammalia. The chimpanzee and the spider-monkey are both quadrumanous and both arboreal, yet the end which is attained in the former by its more perfect hands is reached in the latter by its prehensile tail.

There are many fishes which can resist a tolerably long desiccation, but the means by which they are enabled to do this vary greatly. The Ophiocephalidæ, a small family of fresh-water fishes found in the East Indies, have a cavity capable of contain-

ing water situated inside the head, and accessory to the gill-cavity; the *Labyrinthici*, of which the *Anabas scandens*, or climbing perch, is a well-known example, have an organ composed of thin laminæ, and well suited to contain water, situated in a cavity over the gills, and the gill-opening is narrow; the cuchia (*Amphipurus cuchia*) of Bengal is provided with a sac for the reception of air, and has rudimentary branchiæ, while the three curious fishes forming the sub-class Dipnoi, the Protopterus of West Africa, the Lepidosiren of the Amazon and its tributaries, and the Ceratodus of the rivers of Queensland, Australia, are all provided with a lung-like air-bladder, and have narrow gill-openings and fewer gills than ordinary fishes.

All the fishes mentioned above can bear deprivation of water for more or less time; the Ophiocephalidæ and the cuchia take overland journeys in search of water; the Labyrinthici take some of their prey out of water, are said to be able to ascend trees, and can live for some time in dried mud; and the Protopterus remains alive for many months encased in lumps of the dried mud of the river bed, awaiting only the rainy season to resume its predatory life.

Why may not the extremely long channel formed by the jaw of this rather abnormal member of the goby family be another mode of provision for the requirements of respiration?

The two ordinary gobies (*Gobius lepidus* and *G. Newberryi*), which are found in San Francisco water, although they reside in cavities in the mud or sand, need no such protection as the Gillichthys, since the latter inhabits the tidal sand and mud flats of the sea beach, at such a depth below the surface that it can never be short of water while uncovered by the tide; while the former has not, within my knowledge at least, been found in localities left bare by the tides.

Of the geographical range of the long-jawed goby, to the north of San Francisco, I know nothing, but it extends southward at least as far as the Gulf of California, since I found a single young specimen of it among miscellanea collected there by Mr. W. J. Fisher.

This individual differs from those obtained in the bay of San Francisco in the decidedly reddish tint of the under surface (a slaty gray is the usual color), but this is probably at most only a local peculiarity, as I can detect no other difference.

# THE MUSEUM MITE.

BY ANDREW MURRAY.[1]

THE *Tyroglyphus entomophagus* is the smallest of all the known species of this genus. It is remarkable for the parallelism of the sides, and cylindrical appearance of the body, and for its narrowness, especially in the female. Its legs are shorter than in the other species.

It is a species only too well known to entomologists. It takes up its abode in entomological collections, in the interior of the body, or on the surface of the insects, and in the dust which gathers at the bottom of the drawers or boxes. Large insects, with the body full of fatty particles, those which have been brought up in captivity, and which have not paired, and those which have *become greasy* (to use the technical expression), are the most liable to attack. Certain families of Coleoptera, the large *Scarabæidæ*, like *Oryctes* and *Geotrupes*, the *Lucanidæ*, the *Carabidæ*, the *Dytiscidæ*, and the *Hydrophilidæ*, the *Cerambycidæ*, the large or badly dried *Blaptidæ*, may often be seen covered on the surface with excrement and eggs, under the form of white dots, and sometimes contain a considerable number of these Tyroglyphi in the interior of the body.

The body of the large, especially the nocturnal Lepidoptera, the Cicadæ amongst the Hemiptera, the Earwigs, etc., have them likewise, and the quantity sometimes furnished by such insects, where the mites have once obtained a footing, is truly enormous.

The *Tyroglyphus entomophagus* may be found running upon the back of dead insects, and may be seen without the aid of the microscope. According to M. Perris it gnaws the down and the hairs of the insects attacked. It is, however, chiefly in the inside of their body that it lives ; it gnaws and dilacerates all substances that are soft or deprived of chitine ; hence they are specially destructive to Lepidopterous insects. In handling insects that have been attacked by these Tyroglyphi, we are apt to cause the articulated pieces of which the ligaments have been destroyed to fall asunder, and then there issues from the body a friable matter in which the living Acari swarm.

The friable matter which falls out, when the body of insects gnawed by the *Tyroglyphus entomophagus* is shaken, is composed first, of the excrement of these animals in the form of little round-

[1] Extracted from Economic Entomology : Aptera. By Andrew Murray. London, 1877.

ish grayish masses; secondly, of the eggs in course of development, and of empty shells of hatched eggs, of open and bent shells, cracked often longitudinally; thirdly, of young larvæ and of nymphs, always more numerous than the adult animals; fourthly, of tegumentary envelopes proceeding from the moulting of a great number of larvæ and nymphs; fifthly, of visceral or muscular remains of the body, of pieces of tracheæ, of striated muscular fasciæ, of dried fragments, sometimes of eggs which have not been laid, and which have become loose in the body of the females of the attacked insects.

In the dust at the bottom of the boxes, amongst the remains of all kinds, antennæ, feet, palpi, broken or fallen, one sometimes finds the envelopes of Gamasus, of Glyciphagus, and of Cheyletus Acarids, which live also in collections. Upon the insects themselves, and devouring the excrements and the remains of the Tyroglyphus, M. Perris has found, at Mont-de-Marsan, the larvæ of the *Cecidomyia entomophila.* The walk of the Tyroglyphus entomophagus is slow. It walks with the head bent down, in such a way as to allow the ridge of contact of the two mandibles which go beyond the hairs of the nape of the neck to be seen in front. The males are as numerous as the females, and a little more agile.

It remains to say a few words as to the best means of keeping these mites out of collections, and of getting rid of them when they have once effected an entrance. The insects which are most liable to be attacked by the *Tyroglyphus entomophagus* are, as already said, those which have not been well dried, or which have been placed in ill fitting boxes in a damp room.

When the Tyroglyphus has attacked an insect, one perceives outside little whitish points on the bodies of those with smooth teguments, or on another kind a sort of grayish white powder mingled in the hairs of cottony or downy kinds. Soon under the insect invaded, or on the corresponding sides of the box, one notices a matter of a grayish pulverulent aspect, recalling the efflorescence of saline matters not deliquescent. This dust is said to be quite different from the organic pulverulent debris which results from the ravages of the Anthrenus or Dermestes; these latter produce a fine sawdust, blackish or brownish, but dry and non-adherent. Collections in the south of France, exposed to damp, are very rapidly attacked by Tyroglyphus entomophagus. The mouldiness which shows itself in a collection makes one suspicious of mites, for mould and mites almost always go together.

When an insect is known to be attacked by Tyroglyphus it is best to isolate it in a very dry box. If the insect is glossy the mites which have got into it should be removed with a fine camel-hair brush. If the insect is scarcely attacked, it can be replaced on condition of being watched. But very often one sees reappearing on the body of an insect which has been simply cleaned or brushed, new Tyroglyphi which come from within or from the cavities of the joints where they are apt to gather in large numbers. This shows that the cleansing has been insufficient. One can then have recourse to the heat of the stove or oven. This proceeding is inconvenient when the insect turns out to be what is technically called "greasy." Besides, although the Tyroglyphi may not resist the effect of a high temperature, the eggs often do, especially when they are situated in the interior of the body, and the mites swarm again soon after.

We can scarcely recommend pure water, for if the outside of the dirty insects is washed, it penetrates into the inside, leaving a humidity unfavorable to the object in view.

Alcohol is good for all the insects which can stand its action without being hurt in their colors, hairs, or scales. It will not do for Lepidoptera, but we have often placed beetles that are hard and polished in a flask with a large mouth without taking the trouble of cleaning them. The pin holding the insect is stuck into the under side of the cork, and the body soaks in alcohol without going to the bottom of the vessel. An immersion of several hours or a day is sufficient. Either simple alcohol, or alcohol containing a small solution of corrosive sublimate, will answer. After a bath of an hour in the latter, the insect should be washed in pure alcohol to carry off the sublimate, which, without this precaution, forms a whitish crust and corrodes the pins. We prefer to use alcohol with arsenic or saturated with strychnine, which, in ridding the insects from the Tyroglyphi, has the advantage of preserving them also against the Anthreni.

Besides alcohol, there are liquids which *scour* the insects perfectly, killing the Acarids and carrying off their favorite aliment. These very useful liquids are ether, benzine, essence of naphtha.

Dr. Leconte has utilized the "atomizer" for thoroughly and imperceptibly besprinkling the insects with such liquids.

MM. Grenier and Aubé devised an apparatus for exposing the insects without removal to the vapors of such chemicals. It is a large necrentôme of tin, with fastenings, made with a trench, to be filled with water, so as to submerge the edge of the cover,

and is well adapted for museums and large collections, where the labor of individual cleaning would be too great. But so far as regards mites this is not necessary if the drawers or boxes only fit moderately closely. Then it will be found sufficient to expose a few crystals of pure naphthaline for an hour or two in the drawers. This is the simplest, easiest, and most effectual of all contrivances to destroy mites.

Where it is necessary to treat the insects in detail, another effective but more troublesome plan is to expose the infected insect to the vapor of liquid ammonia, by placing a morsel of sponge in a paint saucer and moistening it with a few drops of powerful liquid ammonia. The insect is placed on a bit of cork alongside of the sponge, and the whole covered by a tumbler or small bell-glass, so as to keep in the vapor; and in ten minutes or a quarter of an hour the cure is generally complete. Sometimes it must be repeated; but this is rarely necessary.

Insects should never be put away until they have been well dried, and, if necessary, freed from fatty visceral matters. This is particularly necessary for kinds brought up in captivity or full of juice at the moment of their capture.

## RECENT LITERATURE.

MURRAY'S ECONOMIC ENTOMOLOGY.[1] — While this work refers at length to such myriopods, spiders and Thysanura as in any way affect man, it is mainly devoted to the mites and ticks, and as such is the only recent and complete manual treating of these important animals which is accessible to the English student. The collections forming the basis of the work are in the Bethnal Green Branch of the South Kensington Museum, and must form a curious department of the museum. This collection is designed for the instruction of the people, and the specimens illustrative of insects injurious to vegetation, or obnoxious to man and the domestic animals, are openly exposed in cases along with colored figures of them, often more or less magnified according to the size of the insect, a practice particularly useful in such minute beings as the mites. Models of injuries done to perishable objects have also been added. It is doubtful, judging by the author's statements, whether there is any other museum either in Europe or America where such a mass of information regarding the habits of troublesome or injurious insects have been spread before the people.

[1] *South Kensington Museum Science Handbooks. Branch Museum, Bethnal Green. Economic Entomology. Aptera.* By ANDREW MURRAY. Prepared at the Request of the Lords of the Committee of Council on Education, and Published for them by Chapman & Hall, 193 Piccadilly, London. 1877. 12mo, pp. 433.

In the case of the mites, not only are European species, but a few of the more prominent North American species are described or referred to, and figures given of them copied from illustrations by American authors.

Not only are the human parasites, as the itch mite, etc., figured, but those infesting our domestic mammals and birds; and the leaf and gall mites and allied forms are noticed at greater or lesser length. As an example of the author's mode of treating his subject, we have reprinted in the preceding pages of this number, an account of a mite which injures dried insects in museums in Europe, and which is undoubtedly the species which occurs under similar circumstances in this country. It appears from Mr. Murray's statements that the flour mite (*Tyroglyphus siro* Linn.) and *Acarus farinæ* or cheese mite, and the milk mite (*Acarus lactis*) are all different names for one and the same species, as is also the *Acarus dysenteriæ* of Linnæus, this mite having in one case caused the dysentery in Rolander, a student of Linnæus. Figures and an interesting account is given of Cross's famous *Acarus*.

The plan of the work is excellent and well carried out, and we sincerely trust that the author will be able, as he designs doing, to furnish us with similar treatises on the "bug, locusts, grasshoppers, cockroaches, and earwigs; the two-winged flies, the bees, wasps, etc.; the dragon-flies and May-flies; butterflies and moths; and lastly, the beetles." These manuals are prepared at the request of the Lords of the Committee of Council on Education, and give evidence of the liberal spirit now pervading the minds of the public men of Great Britain.

Baird's Annual Record of Science and Industry for 1876.[1] — This is the sixth volume of the series, and presents a summary of the most important discoveries in natural and physical science during the year 1876. In addition, a large portion of the book is devoted to abstracts, more or less systematically arranged, of special memoirs, while there is appended a necrology, and a list of the more important scientific publications for the year. Such a book needs a detailed index, and a systematic and analytical table of contents, and we doubt if much fault will be found with the manner in which they have been prepared. Professor Baird has been aided by a number of scientists, whose names are given with the departments which they have reported upon, so that the book carries besides the authority of the name of the editor that of the specialists who have assisted him.

As a handbook of scientific progress this series of annual records is not only indispensable to the general reader, but we doubt not that the specialist who would not be ignorant of what has been done in other departments of science than his own, will find these volumes better fitted to satisfy his thirst for general knowledge than any other with which we are acquainted. The plan of the work leaves in its present state little

[1] *Annual Record of Science and Industry for* 1876. Edited by Spencer F. Baird, with the assistance of eminent men of science. New York: Harper & Brothers. 1877. 12mo, pp. 609.

room for criticism, and the execution seems as a general rule quite worthy of the plan.

Recent Books and Pamphlets. — The Antelope and Deer of America. A Comprehensive Scientific Treatise upon the Natural History, including the Characteristics, Habits, Affinities, and Capacity for Domestication of the Antilocapra and Cervidæ of North America. By John Dean Caton, LL.D. New York: Hurd & Houghton. Boston: H. O. Houghton & Co. 1877. 8vo, pp. 426. $4.00.

Lists of Elevations Principally in that Portion of the United States West of the Mississippi River. Fourth Edition. Collated and arranged by Henry Gannett, M. E. (Misc. Publications, No. 1, U. S. Geological Survey of the Territories. F. V. Hayden, U. S. Geologist in charge.) Washington. 8vo, pp. 167.

Les Arachnides de France. Par Eugène Simon. Tome 2me. Contenant les Familles des Urocteidæ, Agelenidæ, Thomisidæ, et Sparassidæ. Paris, Roret. 1875. 8vo, pp. 358. Four plates. Tome 3me. Contenant les Familles des Attidæ, Oxyopidæ, et Lycosidæ. Paris, Roret. 1876. 8vo, pp. 370, with 4 plates.

Notes on the African Saturniidæ, in the Collection of the Royal Dublin Society. By W. F. Kirby. (Transactions Entomological Society of London. 1877. Part 1, April.) 8vo, pp. 21.

Ueber die in München Gezüchtete Artemia fertilis aus dem Grossen Salzsee von Utah. Von Prof. C. v. Siebold. Basel. 1877. 8vo, pp. 16.

Das Thierleben im Bodensee. Gemein Verständlicher Vortrag. Von August Weismann. Mit einer Tafel. Lindau. 1877. 8vo, pp. 31.

Fragmentarische Bemerkungen über das Ovarium des Frosches. Bemerkungen über die Eifurchung und die Betheiligung des Keimbläschens an Derselben. Von Alexander Brandt. (Zeitschrift für Wissenschaft. Zoölogie. Bd. XXVIII.) Leipzig. 1877. 8vo, pp. 31, with a plate.

United States Commission of Fish and Fisheries. Part III. Report of the Commissioner [Prof. S. F. Baird] for 1873-4 and 1874-5. Part III. Washington. 1876. 8vo, pp. 777.

Brehm's Thierleben. Band 9, Heft 8-13. Leipzig. 1877. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

On the Origin of Kames or Eskers in New Hampshire. By Warren Upham. (From the Proceedings of the American Association for the Advancement of Science. Aug. 1876.) Salem. 1877. 8vo, pp. 10.

A brief Comparison of the Butterfly Faunas of Europe and Eastern North America, with Hints Concerning the Derivation of the Latter. By S. H. Scudder. (From the Proceedings of the American Association for the Advancement of Science. Aug., 1876.) Salem, June, 1877. 8vo, pp. 6.

The Influence of Physical Conditions in the Genesis of Species. By Joel A. Allen. (From the Radical Review, Vol. 1. No. 1, May, 1877.) 8vo, pp. 33.

Lobre Algunos Aracnidos de la República Argentina. Por el Dr. D. T. Thorell. (Periodico Zoölogico, II., pp. 201-218.) 1877.

Études Scorpiologiques. Par T. Thorell. (Extrait du Vol. xix. des Actes de la Société Italienne de Sciences Naturelles. Milan. 1877. 8vo, pp. 198.

Liste Génerale des Articulés Cavernicoles de l'Europe. Par L. Bedel et E. Simon (Extrait du Journal de Zoölogie, IV. 1875.) 8vo, pp. 69.

First Annual Report of the Ohio State Fish Commission for the Years 1875 and 1876. Columbus. 1877. 8vo, pp. 96, with cuts.

On the Inhabitants of the Admiralty Islands, etc. By H. N. Moseley. (Reprinted from the Journal of the Anthropological Institute. May, 1877.) 8vo, pp. 52, 4 plates.

The Early Stages of Hippa talpoidea, with a Note on the Structure of the Mandibles and Maxillæ in Hippa and Remipes. By S. I. Smith. (From The Transactions of the Connecticut Academy, Vol. iii. 1877.) 8vo, pp. 31, 4 plates.

Principal Characters of the Coryphodontidæ. Characters of the Odontornithes, with Notice of a New Allied Genus. Notice of a New and Gigantic Dinosaur. By O. C. Marsh. (From the American Journal of Science and Arts, xiv. July, 1877.) 8vo, pp. 8, 2 plates.

Zur Entwickelungsgeschichte der Dekapoden. Von Paul Mayer. (Abdruck aus der Jenaische Zeitschrift, für Naturwissenschaft, Bd. xi.) 8vo, pp. 81, 3 plates.

On the California Species of Fusus. 8vo, pp. 5. Preliminary Descriptions of New Species of Mollusks from the Northwest Coast of America. 8vo, pp. 6. By W. H. Dall. (From the Proceedings of the California Academy of Science, March 19, 1877.)

On the Brain of Procamelus occidentalis. By E. D. Cope. (From the Proceedings of the American Philosophical Society.) Published June 15, 1877. 8vo, pp. 52, with a plate.

On the Vertebrata of the Bone Bed in Eastern Illinois. By E. D. Cope. (From the Proceedings of the American Philosopical Society.) Published June 20, 1877. 8vo, pp. 11.

Ueber den Ursprung der Blumen. Von Dr. Hermann Müller. (Aus Kosmos.) 1877. 8vo, pp. 14.

Ueber Bau und Entwickelung des Stachels der Ameisen. Von Dr. H. Dewitz. (Siebold und Kölliker's Zeitschrift, xxviii.)

The Tailed Amphibians, including the Cæcilians. A Thesis: Presented to the Faculty of Michigan University. By W. H. Smith. Detroit. 1877. 12mo, pp. 158.

Tribes of the Extreme Northwest. By W. H. Dall. (Department of the Interior. U. S. Geographical and Geological Survey of the Rocky Mountain Region. J. W. Powell, Geologist in Charge. Part 1.) 1877. 4vo, pp. 106, with a map.

History of the American Bison, Bison Americanus. By J. A. Allen. (Extracted from the Ninth Annual Report of the U. S. Geological Survey. F. V. Hayden in charge.) Washington. 1877. 8vo, pp. 587.

Ethnography and Philology of the Hidatsa Indians. By Washington Matthews. (Miscellaneous Publications, No. 7, U. S. Geological and Geographical Survey. F. V. Hayden in charge.) Washington. 1877.

## GENERAL NOTES.

### BOTANY.[1]

Illustrations of North American Ferns. — It gives us sincere pleasure to learn that it is proposed by Mr. S. E. Cassino to publish an illustrated popular work on our ferns. The announcement is made that the drawings will be from sketches by Mr. J. H. Emerton, and that the text will be furnished by Professor Eaton. The latter is a recognized authority thoroughly familiar with American ferns; Mr. Emerton's skill as a draughtsman is well known to our readers. The plates are to be in color, and the work is promised at an exceedingly low price.

Acer dasycarpum. In 1843, Mr. Emerson measured a tree of this species, growing in the town of Stockbridge, Mass., when at three feet from the ground, it girted twelve feet. In October, 1876, the same tree was measured by Mr W. R. Robeson, who reports that its circumference at the same height, was then fifteen feet and nine inches, showing an annual average increase of circumference during the last thirty-three years of a little over 1.36 inches. — C. S. Sargent.

[1] Conducted by Prof. G. L. Goodale.

Observations on Silphium laciniatum, the so-called Compass Plant.[1] — For the past six or eight years there has been little doubt of the curious polarity of the root and stem-leaves of the large coarse plant known throughout the prairie regions by the name of the compass plant. It appears, however, that few accurate measurements of the bearings of these leaves have been made. So that while they are now considered as pointing more or less to the north, but little is known as to how nearly they arrange themselves upon the meridian. In order to contribute to a better knowledge of this matter, I have for several years been making observations, the results of which I herewith transmit: —

TABLE I.

Bearings of the leaves of fourteen small plants, many of which had but one leaf each: —

| | |
|---|---|
| North 1° 30′ East. | North 4° 30′ West. |
| " 1° 45′ " | " 7° 30′ " |
| " 1° 45′ " | " 8° 30′ " |
| " 5° 30′ " | " 9° 15′ " |
| " 6° 0′ " | " 13° 30′ " |
| " 6° 30′ " | " 22° 15′ " |
| " 8° 0′ " | " 25° 0′ " |
| " 21° 30′ " | " 29° 30′ " |
| " 82° 30′ " | " 34° 0′ " |
| | " 34° 0′ " |
| | " 37° 0′ " |
| | " 61° 45′ " |
| | " 71° 45′ " |

Fifty per cent., it will be observed, deviated less than ten degrees, and eighty-six per cent. less than forty-five degrees from the meridian.

TABLE II.

Bearings of thirteen leaves, all of which grew on one large plant: —

| | |
|---|---|
| North 0° 30′ East. | North 0° 30′ West. |
| " 0° 45′ " | " 1° 15′ " |
| " 3° 30′ " | " 35° 30′ " |
| " 3° 45′ " | " 88° 0′ " |
| " 3° 45′ " | |
| " 10° 30′ " | |
| " 17° 30′ " | |
| " 36° 0′ " | |
| " 89° 30′ " | |

Fifty-four per cent. of these leaves deviated less than four degrees from the meridian, and eighty-five per cent. less than forty-five degrees.

TABLE III.

Bearings of the leaves of a medium sized plant: —

| | |
|---|---|
| North 1° 0′ East. | North 0° 15′ West. |
| " 1° 30′ " | " 0° 30′ " |
| | " 0° 30′ " |
| | " 20° 0′ " |
| | " 56° 0′ " |

[1] See an article on this subject in The American Naturalist for March, 1871, where may be found also references to other papers. An article appeared some years since in the American Agriculturist, and another recently in Nature, in which good cuts of the compass plant were given.

Of these seventy-one per cent. deviated less than two degrees, and eighty-five per cent. less than forty-five degrees from the meridian.

TABLE IV.

Bearings of the leaves of a large plant: —

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| North | 0° | 0′ | East. | North | 17° | 0′ | West. |
| " | 2° | 30′ | " | " | 32° | 0′ | " |
| " | 3° | 0′ | " | " | 35° | 0′ | " |
| " | 11° | 0′ | " | | | | |
| " | 13° | 0′ | " | | | | |
| " | 16° | 15′ | " | | | | |
| " | 40° | 15′ | " | | | | |

It will be observed that, with a good deal of variation in the bearings, none of the leaves diverge as far from the meridian as forty-five degrees.

TABLE V.

Bearings of the leaves of another large plant: —

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| North | 5° | 0′ | East. | North | 2° | 30′ | West. |
| " | 9° | 30′ | " | " | 3° | 45′ | " |
| " | 12° | 45′ | " | " | 4° | 45′ | " |
| " | 14° | 30′ | " | " | 23° | 30′ | " |
| " | 14° | 30′ | " | " | 45° | 30′ | " |
| " | 20° | 30′ | " | | | | |
| " | 21° | 0′ | " | | | | |
| " | 28° | 30′ | " | | | | |
| " | 29° | 30′ | " | | | | |
| " | 31° | 45′ | " | | | | |

Thirty-three per cent. deviated less than ten degrees, and ninety-three per cent. less than forty-five degrees from the meridian.

TABLE VI.

Bearings of the leaves of ten plants, large and small: —

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| North | 1° | 45′ | East. | North | 6° | 30′ | West. |
| " | 1° | 45′ | " | " | 7° | 45′ | " |
| " | 3° | 30′ | " | " | 12° | 15′ | " |
| " | 4° | 15′ | " | " | 13° | 30′ | " |
| " | 6° | 45′ | " | " | 21° | 20′ | " |
| " | 7° | 0′ | " | " | 23° | 30′ | " |
| " | 7° | 45′ | " | " | 30° | 0′ | " |
| " | 12° | 45′ | " | " | 33° | 30′ | " |
| " | 16° | 0′ | " | " | 43° | 0′ | " |
| " | 18° | 45′ | " | | | | |
| " | 37° | 45′ | " | | | | |
| " | 39° | 0′ | " | | | | |
| " | 41° | 15′ | " | | | | |
| " | 42° | 15′ | " | | | | |
| " | 42° | 30′ | " | | | | |
| " | 46° | 0′ | " | | | | |
| " | 52° | 15′ | " | | | | |

Thirty-four and one half per cent. of these leaves deviated less than ten degrees from the meridian, and ninety-two per cent. less than forty-five degrees.

Taking the bearings of all the leaves observed (ninety-three in all), we find that about thirty per cent. did not vary more than five degrees, forty-two per cent. not more than ten degrees, and ninety per cent. not more than forty-five degrees from the meridian.

If now we tabulate the bearings so as to indicate how many lie between 0 and 5° east, between 5° and 10° east, and so on, we have —

TABLE VII.

| From | to | East | leaves | From | to | West | leaves |
|---|---|---|---|---|---|---|---|
| From 0 | to 5° | East, | 18 leaves. | From 0 | to 5° | West, | 9 leaves. |
| " 5° | to 10° | " | 8 " | " 5° | to 10° | " | 5 " |
| " 10° | to 15° | " | 7 " | " 10° | to 15° | " | 3 " |
| " 15° | to 20° | " | 4 " | " 15° | to 20° | " | 2 " |
| " 20° | to 25° | " | 3 " | " 20° | to 25° | " | 5 " |
| " 25° | to 30° | " | 2 " | " 25° | to 30° | " | 2 " |
| " 30° | to 35° | " | 1 " | " 30° | to 35° | " | 5 " |
| " 35° | to 40° | " | 3 " | " 35° | to 40° | " | 2 " |
| " 40° | to 45° | " | 4 " | " 40° | to 45° | " | 1 " |
| " 45° | to 50° | " | 1 " | " 45° | to 50° | " | 1 " |
| " 50° | to 55° | " | 1 " | " 50° | to 55° | " | 0 " |
| " 55° | to 60° | " | 0 " | " 55° | to 60° | " | 1 " |
| " 60° | to 65° | " | 0 " | " 60° | to 65° | " | 1 " |
| " 65° | to 70° | " | 0 " | " 65° | to 70° | " | 0 " |
| " 70° | to 75° | " | 0 " | " 70° | to 75° | " | 1 " |
| " 75° | to 80° | " | 0 " | " 75° | to 80° | " | 0 " |
| " 80° | to 85° | " | 1 " | " 80° | to 85° | " | 0 " |
| " 85° | to 90° | " | 1 " | " 85° | to 90° | " | 1 " |
| Total leaves East, 54. | | | | Total leaves West, 39. | | | |

In one case (Table VI. in part) of twenty-eight leaves examined, all but three had rotated upon their petioles in assuming their positions, that is, they *twisted* their petioles; of these twenty rotated with the sun, and five against it. Of the three remaining leaves, two rotated their two half blades upon their midribs, so that *both edges* tended to point towards the north; the remaining leaf did not show any evidence of rotation in either direction, and its bearing was seven degrees east of north.

In another case (the second leaf in Table I.) a leaf was found to have rotated through at least 270° of arc to reach its final position. Originally it stood with one edge nearly due east, and the other west; the western edge then rotated northward, passed the zero point and swung away round to the south, passing 1°45′ beyond that point. This rotation was all confined to the petiole.

How to account for this evident turning has been, and still is a puzzling thing. In order to see whether there was any diurnal rotation, or turning, such as is observed in the sunflower, I carefully set stakes in line with several leaves having quite different bearings, and watched them closely for about a week, but failed to discover the least tendency to any such motion.

Dr. Gray, I believe, first made the suggestion that the structure of the leaf must have something to do with their so-called "polarity," and made some examinations as to the number of stomata upon the two surfaces. I have made many examinations by the aid of the microscope, and have determined that in the central part of a full grown leaf the stomata are at the rate of 52,700 to each square inch of upper surface, and 56,-300 to each square inch of lower surface. In this calculation I made no account of the veins, which apparently occupy an equal area on both surfaces. They probably take up fully one half the surface, and they are destitute of stomata.

Five years ago I examined the two surfaces of quite young leaves,

and after many observations found that the relative numbers were as ninety stomata to the upper, and eighty-seven to the lower surface. A year later the average of three observations on older leaves gave as the relative numbers, sixty-two for the upper, and sixty-nine for the lower surface. Again, in 1874, averages of carefully made observations upon young leaves gave as relative numbers forty-nine for the upper surface, and fifty-nine for the lower. Observations made at the same time upon old leaves gave the numbers fifty-seven for the upper, and seventy-five for the lower surface.

Now by comparing these results with the number of stomata in the leaves of other plants, we arrive at the value of the greater or less abundance of these on either surface as influencing the direction of the leaves. In 1872 I examined the leaves of the common sunflower (*Helianthus annuus*, var.) and found that the stomata of the upper surface were to those of the lower as 102 to 105. In 1874 I found after repeated observations that the stomata on a cabbage leaf were as seventy for the upper surface to eighty-six for the lower.[1] Now these numbers are so nearly like those found in *Silphium*, that we conclude that the mere number of stomata can have little if anything to do with determining polarity, for in both of these cases there is an utter want of it. I think we may then with reasonable safety throw the stomata out of the question for it is *very doubtful if they alone* have anything to do with it. The texture of the leaf must be more carefully examined than it has yet been to enable us to determine the real cause of the polarity. We know that some leaf surfaces, generally the upper — turn quickly and forcibly towards the sun, as is notably the case in the sunflower mentioned above; the cause of this heliotropism we do not know: now if we conceive a leaf with its two surfaces endowed with this sensitiveness to light, or, in other words, if both sides are equally heliotropic, the leaf will, in the struggle of the two sides for the greater share of light, be compelled to assume a position similar to that taken by the leaves of *Silphium laciniatum*; but here we need further facts. — C. E. Bessey, Ames, Iowa.

Precocity of Blossoming in the Orange. — In general it takes the orange tree, in the most favorable localities in Florida, at least five years from the sowing of the seed to produce the flowers and fruit, and

[1] Adolph Weiss records in Jahrb. für witsen. Bot. volume iv. 1865, that he found the stomata to exist in the following proportions upon the two surfaces, namely: —

| | | | | |
|---|---|---|---|---|
| *Helianthus annuus*, | upper surface | 175, | under surface | 325. |
| *Brassica oleracea*, | " | 219, | " | 301. |

Which differ considerably from my proportions. However, some of his other plants are almost equally good examples for my purpose, as —

| | | | | |
|---|---|---|---|---|
| *Datura stramonium*, | upper surface | 114, | under surface | 189. |
| *Chenopodium ambrosioides*, | " | 184, | " | 156. |

Morren, in Bull. de l' Academie Royale de Belgique, gives the following proportions, namely: —

| | | | | |
|---|---|---|---|---|
| *Trifolium pratense*, | upper surface | 207, | under surface | 335. |
| *Helianthus annuus*, | " | 137, | " | 242. |

often this time is extended to ten years. This year, however, all over the State, numerous instances have occurred in which seedling oranges of not as many months old produced blossoms — the baby trees varying in height from one and a half to six inches. Several of these have been exhibited in Jacksonville. Of about one hundred oranges which had come up from seed planted by Judge Hayden in December, 1876, seven had a perfect flower at the top, in the following April, and when they were only an inch and a half high. These remarkable instances of premature blossoming are, I think, worthy of being recorded. — HENRY GILLMAN, Waldo, Florida.

PLANTS OF BRAZIL AND GERMANY. — Fritz Müller gives in *Flora*, an interesting account of a recent journey to the highlands of his Province, St. Catharina, and the head waters of the river Uruguay. He found many plants which reminded him, by their *facies*, of the plants of Germany. The violets, especially, were very near those of Germany. He observes that the minuter flowers of a white violet are not only cleistogamic, but are developed *under* the soil. It may be remembered that some of our Eastern species, notably V. sagittata, have late inconspicuous flowers which are very fertile. So far as we are aware, these late flowers of our violets are above and not under ground. Müller had not noticed in the lowlands any seeds or fruits which bury themselves in the ground, but on the higher plain he observed many which have marked hygroscopic properties by which they can bore their way into the soil.

CELTIS OCCIDENTALIS. — A very old specimen of this tree is growing in an exposed situation close to the shore near the Squantum Beach Hotel in the town of Quincy, Mass. Its size is worthy of record. At the ground it has a circumference of eleven feet and four inches, and at five feet from the ground, just where its short stem is the smallest, it girts seven feet. A still finer specimen stands in the city of Lowell, and this at four feet from the ground girts seven feet six inches. This is the tree of which a photograph appears in Emerson's Trees and Shrubs of Massachusetts, second edition, where it is called *Celtis crassifolia*, although in foliage and fruit it is identical with the form of *C. occidentalis* common in the Eastern States.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Bulletin of the Torrey Botanical Club.* May and June. Notes on the Botanical Geography of Syria. (An interesting account of the seven botanical regions into which Syria is divided, namely: (1.) The dunes, or hills of drifting sand. (2.) The littoral plain. (3.) The median mountain region. (4.) High Lebanon and Hermon. (5.) The high lake-bed. (6.) Valley of the Jordan and the Dead Sea. (7.) The desert.) Mr. Miller sends notes of Suffolk County notes. C. F. Austin, New Hepaticæ.

*Botanical Gazette.* Professor Porter gives in the July number an interesting account of some variations in mandrake, or may apple, *Podophyllum peltatum*, and Mr. Shriver has a few notes on *Nepeta* and *Draba*.

*Trimen's Journal of Botany.* June. W. G. Smith, A new species of *Xerotus X. sanguineus.* J. G. Baker, New Ferns from the Andes of Quito. A. W. Bennett, Review of the British species of *Polygala.* E. M. Holmes, The Cryptogamic Flora of Kent. Several extracts and excellent abstracts, together with a notice of the Botanical Garden at Copenhagen, and the titles of articles in botanical journals close the number.

*Flora,* No. 13. Dr. George Winter, Lichenological notices (continued in No. 14). F. v. Thümen, Notes on "Mycotheca Universalis." No. 14. Emil Godlewski. Is the product of assimilation in Musaceæ (the Banana tribe) oil or starch? (Answer, "Everything shows that the product of assimilation in the species of *Musa* and *Strelitzia* is not oil, as Briosi states, but starch, just as in other plants.") Nylander. Additions to European Lichenography (continued in No. 15). No. 15. M. Gandoger, New Roses in South Eastern France, Fritz Müller, a Letter from Brazil (noticed elsewhere).

*Botanische Zeitung,* No. 21. G. Kraus, The Occurrence of Inulin in other plants than Compositæ. (The writer has detected Inulin in the allied orders Campanulaceæ and Lobeliaceæ [which, by the way, have been united as tribes under one order by Bentham and Hooker], in Goodeniaceæ and Stylideæ.) No. 22. Dr. Brefeld, On the Entomophthoræ (an order of Fungi) and their allies (continued in 23). No. 23, Dr. G. Haberlandt, On the Origin of Chlorophyll Granules in the Germ-Leaves of *Phaseolus vulgaris.* No. 24, conclusion of the preceding article by Haberlandt. "I believe that I have now shown that *true* chlorophyll granules can arise, as v. Mohl pointed out, by the enveloping of starch granules with colored protoplasma." No. 25, Professor Schenk, On the Relations of Structure of Fossil Plants. Reports of Societies.

## ZOÖLOGY.[1]

The Branchiæ of the Embryo Pipa. — In *Nature* for April 5, 1877, is an interesting article, author not stated, upon The Development of Batrachians without Metamorphosis. On page 492 occurs the following passage: "The young of *Pipa Americana* [the Surinam toad] come forth from the eggs laid in the cells on their mother's back, tailless and perfectly developed. In them, likewise, no one has yet detected branchiæ." Two points here made are not in accordance with the observations of the late Prof. Jeffries Wyman, as recorded in the *American Journal of Science and Arts,* 1854, second series, vol. xvii. pp. 369–374.

Wyman states that the eggs are transferred by the male to the back of the female, which presents "a uniform surface throughout;" "their presence excites increased activity in the skin, it thickens, and is gradually built up around each egg, which it at length incloses in a well-defined pouch."

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

On pages 370 and 371 he figures and describes the earlier embryos as having "three branchial appendages on each side of the head. In a later stage the external branchiæ had disappeared, but a small branchial fissure was detected on each side of the neck, and within this on each side a series of fringed branchial arches."

Wyman's figures are evidently enlarged, and he gives no measurements of the embryos. But his figures and descriptions are explicit, and I am not aware that any statement by him has ever been found to be incorrect.

In view, however, of the passage above quoted from *Nature* I have endeavored to obtain confirmation of Wyman's statement. On examining two embryos from cells upon a Pipa presented to me by Dr. J. B. S. Jackson, I found them very ill preserved. They measured fourteen mm. from tip to tip, and I could find no trace of branchiæ internal or external. I then suggested to Dr. Jackson an examination of some better-preserved examples in the Warren Anatomical Museum of the Medical College of Harvard University. The examination was made by Mr. C. S. Minot, who reports as follows: —

"I have examined two eggs from the back of the Pipa, and found the embryos a little more advanced than that figured by Professor Wyman; they are between twelve and thirteen mm. in length. The gills were partly absorbed, but a single slit with the gills still projecting could be readily seen on each side at the back of the head. I could not make a more detailed examination, as the eggs were not well enough preserved."

We may conclude, then, pending the extended examination of a series of perfectly preserved embryos, that the Pipa does possess external branchiæ at a certain period before hatching. — BURT G. WILDER.

MAMMALS NEW TO THE UNITED STATES FAUNA. — I am desired by Dr. J. C. Merrill, U. S. A., to record the capture by him at Fort Brown, Texas, of two species of Mammals not previously found in the United States. One of these is the *Felis yaguarundi*, and the other is a species of *Nasua*.

*Felis yaguarundi* was introduced into our fauna in 1857, by Professor Baird, in his Mammals of North America, his material consisting of a skull collected by Dr. Berlandier at Matamoras, Mexico. It was then first recognized as an inhabitant of the valley of the Lower Rio Grande, but it is only now actually taken in United States territory. It is described as larger than the common house-cat, and more elongated in all its proportions, with the tail as long as the body exclusive of the head, and the prevailing color a continuous grizzled brownish-gray without any spots. An extended account is given in the Mexican Boundary Report, vol. ii. pt. ii., page 12 (1859). The skin which Dr. Merrill has transmitted to the Smithsonian was obtained from a Mexican who shot the animal a few miles from Fort Brown, Texas. "Last summer," writes Dr.

Merrill, "while duck shooting at a lagoon about six miles from the fort, I saw one of these cats come out of some thick chaparral and run across an open resaca, within seventy-five yards of me. The long tail and gray color were distinctly seen and unmistakable."

The occurrence of the *Nasua* is particularly interesting, as it adds not only a species but a genus and family of mammals to our fauna. Dr. Merrill kept the coati some time in confinement, but finally killed it, and transmitted the specimen to the Smithsonian. It is unfortunately not in very good order, having been attacked by insects, but will answer for identification. It is probably the species referred to on page 22 of the Mexican Boundary Report as "*Nasua fusca*," under which name the Berlandier MS. speaks of a coati as common in Tamaulipas. Dr. Merrill took the following description from the living animal: —

*Female.* Nose to base of tail, about twenty-two inches; tail vertebræ, twenty; tail with hairs, twenty-one. General color, grayish yellow, the hairs lighter at the ends; shoulders and other parts yellowish-white; tail brownish-yellow, darker towards the tip, in form very thick at the base and gradually tapering; feet black, five-toed, claws long; ears small and rounded; snout long, slender and flexible, extending one and one half inches beyond upper incisors; top of head yellowish; three white spots, one above, another beneath, and a third three fourths of an inch behind, the eye; terminal inch and a half of snout with whitish hairs; rest of face brownish; nose black. She is quite tame, is a great mouser, and makes a very amusing pet." — Elliott Coues, Washington, D. C.

Spontaneous Adaptation of Color in the Lizard. — The lizards are of great beauty and variety in Florida, and are generally not easily alarmed, and so tame as to afford good opportunity for observing their characters and habits. Their having the capacity of, chameleon-like, changing color, has, I believe, been questioned. Since my residence here, I have had ample means of determining the point, and can positively state that they possess the power to which I have reference in a remarkable degree; indeed I was unprepared for the extreme development of this curious gift, which they spontaneously exhibit. For instance, I have seen a small yellowish-brown lizard, on quitting the ground, instantly assume the dull gray hue of the weather-beaten fence-rail it glided upon and along. Passing under some olive-tinted foliage, it would next adopt that color, to be succeeded by a full bright green of emerald-like glow, as it reached and rested underneath the sprays of grass and other leaves of corresponding shade. The original yellowish-brown color would again be assumed on the lizard returning to the ground. Each of the changes mentioned appeared to be almost instantaneous, and the entire series could not have occupied much more than one quarter of a minute of time.

At Santa Fé Lake, in Alachua County, these interesting little creatures are uncommonly abundant. They frequently enter dwellings, bask-

ing on the window-sill or gliding like a sunbeam along the back of a chair; and some are so tame that they permit themselves to be stroked with a straw. — Henry Gillman, Waldo, Florida.

Supposed Development of Pickerel without Fecundation. — March 15, 1875. The boys brought in some brook pickerel. One was swollen with spawn, weight of fish 521 grains; of spawn freed from membrane, 127 grains, 117 spawn weighed 5 grains. Therefore whole number about 2972.

This spawn was amber colored, and the eggs were in general translucent. Occasionally an egg could be seen which was slightly smaller than the rest, and clouded, and some few were opaque. These eggs, thus marked, presented different appearances under the microscope. I have mislaid the notes and drawings that I took at the time, but can furnish the following facts from memory. The clouded eggs showed a different development from the others, there being a greater difference in size of the cells, and occasionally the cells arranged in lines. Some of the opaque eggs had evidently developed in the line of the fecundated egg, as the cells were arranged in the form of a curled fish, the line of the back being well defined, the line of the belly and sac poorly or not at all defined, while there was a concentration of cells about the locality of the eye. I cannot say that I saw a young fish, for I did not, but I saw what I considered sufficient to interpret as development to a certain degree, without fecundation.

I was so much surprised, that for a time I doubted my own eyesight, and called my brother to look. He saw what he called a young fish in the egg, and so I was convinced, but I had not the courage to send my observations to men of science.

This next spring I will try and procure some fresh specimens, and if my observations can be verified, as I doubt not but that they can be, I will send them to you.

I should not consider this memorandum worthy of being forwarded to you, were it not for the encouragement of your letter, and I am fully as aware that such incompleteness can be of little value to science. Yet I am somewhat familiar with the microscope, and have studied the ovary of young calves, both in a fresh and injected state, and have had sufficient experience to eliminate imagination from my results, and recognize facts. I therefore have confidence that I saw what I have so imperfectly outlined, and I hesitate to ask others to believe, on account of their wonderful nature, that there can be such a development without fecundation in a vertebrate. — E. Lewis Sturtevant, South Framingham, Mass., July 8, 1877. (Communicated by the Smithsonian Institution.)

## ANTHROPOLOGY.

THE CLASSIFICATION OF STONE IMPLEMENTS. — The kindly criticism of my descriptions of the Indian relics found in New Jersey, in the Smithsonian Annual Report for 1875, by O. T. M., wherein he remarks that the writer has shown too great a fondness for classifying the various forms met with, suggests the propriety of offering a few remarks on the absolute necessity of field-work, in correctly pursuing archæological study, at the same time without intending to intimate that my lenient critic is not competent to pass judgment; for certainly it cannot be said of the Smithsonian collections which he has studied that they have been ignorantly gathered, but archæological specimens of themselves, purchased of dealers or picked up by others than students of the subject, are in a great measure valueless as helps to unravel any ethnological puzzle. I cannot conceive of a position in which one is more liable to fall into errors than in judging of the uses of stone implements from their shapes only. It cannot, in fact, be shown that the same pattern might not have had a far different use on the Atlantic coast from the present use of such a form in the far West. The "leaf-shaped arrowheads" are stated to be used only as knives in Colorado and Utah, but were doubtless also arrowheads in New Jersey. It must be remembered, too, that the varieties of stone implements are by no means endless. Rather their limited range of forms renders it obvious that the surroundings of a sea-coast tribe necessitate a different use for many of the simpler shapes than that of such tribes as occupied a mountainous region. The varieties of game, the pursuit of a primitive agriculture, and a hill-tribe's general surroundings suggest at once uses for characteristic forms found there that would not be true of like forms found along the coast. This brings me to my subject proper, which is to insist that our *safest* guide in studying the relics of a locality long since deserted by its aboriginal occupants is the circumstances surrounding the discovery of every specimen found. To accomplish this an archæologist must be his own collector. Fully convinced of this, I have personally gathered several thousands of relics from a tract of about one thousand acres, and have by no means exhausted the supply; and this laborious field-work resulted in the conviction that such and such a form was for this or that purpose, as a rule. As an illustration, let me instance those long, slender, tapering spears, which I have called "fishing spears." The conclusion that they were used solely (?) for such a purpose was based on the fact that they are essentially (that is, in this locality) a "water find." From the Delaware River, and especially from the deep mud of Crosswick's Creek, I have dredged numbers of this pattern; and when found on the surface I believe they have always been very near the larger creeks and the river.

This association, coupled with the shape of the specimens, which is one admirably adapted to spearing fish, I submit, quite naturally suggests

such a use of this particular variety; but the precise range of use of any one form of stone implement can scarcely be brought down to a mathematical demonstration. I cannot go further into detail, but will add that as in the case of fishing spears, so with many other forms, of which, perhaps, I have spoken too confidently; but I still submit that the field rather than the cabinet is the proper place to study stone implements.

With reference to the division of the Stone age in New Jersey into an older and a later stage, I will but say that what I deem a conclusive demonstration of the correctness of this opinion will shortly be published in considerable detail, and until then on this most important point will gladly "rest our case." — CHARLES C. ABBOTT.

ANTHROPOLOGICAL NEWS. — In *Nature* for April 5, 1877, is a full report of a lecture delivered at the Royal Institution, London, by Francis Galton. The object was to show how individuals of different generations resemble each other so closely, while individuals do not necessarily tend to leave their like behind them, especially if they depart from the average; yet, on the whole, the proportion of gradation of long and short, strong and feeble, and dark and pale appears to be constant. The author displays his accustomed ingenuity in the arrangement of his illustrative diagrams.

The committees on the "historical exhibition of ancient art in all countries, and of the ethnography of peoples foreign to France," to be opened at the Universal Exposition at Paris, in 1878, so far as appointed stand as follows: Adrien de Longperier, director; Gustav Schlumberger, general secretary. A commission of admission and classification, divided into nine sections, is charged with preparing and organizing the exhibit. The following gentlemen will preside over the sections: —

1. Primitive art and antiquity of Gaul, Alexander Bertrand, Jules Desnoyers, the Marquis of Vibraye, Frederic Moreau, Dr. Hamy.

9. Ethnography of peoples outside of France, Alphonse Pinart, J. L. Gerome, Albert Goupil, Dr. Hamy, Henri de Longperier.

Mr. D. B. Perry contributes to the *Saline County News*, published at Crete, Nebraska, an interesting letter on the Pawnees, correcting some mistakes made in Appleton's Cyclopedia, and pays a handsome tribute to Mrs. E. G. Platt, who spent many years among them. It is to be hoped that Mrs. Platt will give some permanency to her knowledge of this rapidly perishing tribe.

Volume iii., No. 1, of Prof. F. V. Hayden's Bulletin is out, and contains the following papers on anthropological matters: —

I. A Calendar of the Dakota Nation, by Bvt. Lt.-Col. Garrick Mallery, U. S. A., with a plate.

II. Researches in the Kjökkenmöddings and Graves of a Former Population of the Coast of Oregon, by Paul Schumacher. Seven plates.

III. Researches in the Kjökkenmöddings of a Former Population of

Santa Barbara Island and the Adjacent Mainland, by Paul Schumacher. Fourteen plates.

IV. The Twana Indians of the Skokomish Reservation, by Rev. M. Eells. Three plates.

The first paper is a very ingenious device of the Dakotas to represent the leading events of a series of years extending from 1800–1871. Of Mr. Schumacher's wonderful discoveries we have often spoken in terms of praise. Mr. Eells' paper is an elaborate set of answers to the pamphlet of directions sent to collectors for the Centennial Exhibition.

Dr. Frederick D. Lente, of Palatka, Fla., contributes to the March and April numbers of the *Semi-Tropical*, published at Jacksonville, two very interesting papers on the mounds of Florida. The doctor deserves great credit for this useful expenditure of his own leisure and for the advice conveyed in his papers concerning the good effect upon the minds and bodies of invalids, to be realized by seeking out-of-door amusement and occupation.

In 1872 M. Kouznetzoff was sent by the Russian government through the Lithuanian provinces to study their ethnography. The result of his labors occupies four volumes and a chart. The Lithuanian language has been encroached upon by the Prussians on the west, the Russians on the northeast, and by the Poles on the south. The study of this ancient branch of Aryan speech is made very interesting by the theory of Omalius, published in 1865, that the Aryan races are of European and not of Asiatic origin.

Dr. José Dionisio Anchorena sends to the Smithsonian Institution a copy of his Gramatica Quechua, o del Idioma del Imperio de los Incas. Lima. 1874.

Professor Huxley, in his lecture at the Kensington Museum, on Saturday, December 16, 1876, defined the boundaries of biology, stating that biologists surrendered all that part of the field which relates especially to the history of man as a social and moral being. Anthropology has been defined as the "biology of man;" but the restriction of the term "biological anthropology" to the application of Professor Huxley's definition to mankind will suit the meaning given to this term by M. Broca in his opening lecture before the Institut d'Anthropologie.

Another periodical, just started in Paris by MM. H. Gaidoz and E. Rolland, attests the growing interest in anthropological matters. It is called *Mélusine, Revue de Mythologie, Littérature Populaire, Traditions, et Usages.* While aiming to collect the myths and folk-lore of France in particular, it will cover the whole field of mythology and legend.

The Rev. Stephen D. Peet, Ashtabula, O., has issued a circular of the Archæological Exchange Club, containing the conditions of membership. The object is to effect an exchange of fugitive publications on archæology. We hail with especial commendation this effort to make our scattered archæologists better acquainted.

In the *Bulletin de la Société d'Anthropologie*, 1876, M. Bertillon contributes a paper on the influence of primogeniture on sexuality. The annual births in France are, in wedlock, 105 males to 100 females, liveborn; dead-born, 137–100; all births, 106.6: 100. The illegitimate births reduce the ratio to 103.1 : 100. In Austria the births are 106 : 100; first-borns 110.3 : 100; puines, 105.2 : 100. Illegitimate first-borns, 103.6 : 100; illegitimate puines, 105.8 : 100. In the capital cities the first-borns were 114.4 : 100; puines, 106 : 100. Illegitimate first-borns, 102.1 : 100; illegitimate puines, 106.6 : 100. The subject was ably discussed by Lagneau and others, and was reverted to in a subsequent meeting. In the same journal, page 25, Dr. Paul Topinard discusses the "parietal angle" of M. De Quatrefages. Blumenbach, in 1775, arranged skulls in a line on the floor, and observed them from above, on the *norma verticalis.* Viewed in this way the zygomatic arches are more or less prominent, giving rise to the terms cryptozygous (white races) and phænozygous (yellow races). Prichard, in 1813, added the profile and face view, *norma parietalis* and *norma frontalis.* Owen introduced the study of the base, *norma basalis.* Prichard in directing his attention to the front view of the skull, enunciated his celebrated form called ogival. To verify his experiment, De Quatrefages invented his parietal goniometer, exhibited before the Academie des Sciences in 1858, and at the French Association in 1872. The parietal angle is formed by two lines tangent to the most salient points of the zygomatic arches and to the coronal suture. When the lines meet above, the angle is positive; when they meet below, the angle is negative. The positive angle is most marked in the yellow races; the negative in the fœtus, and in some European adults.

In the third number of the *Bulletin de la Société d'Anthropologie*, M. De Mortillet has a paper on France in prehistoric times. It was read on the occasion of presenting to the society his chart on prehistoric France, prepared for Nouvelle Geographie Universelle of Elisée Réclus. Tables are given containing the number of localities in every district of the country. Something of the kind might be attempted in our own land. In the same journal are the following communications: Découverte de gisements néolithique à Moret (Seine-et-Marne). Sépulture à crémation, trépanation chirurgicale, et trépanation posthume, by M. Choquet. Étude sur une série de crânes recueillis dans le département du Puy-de-Dome, by M. Boyer. Quelques observations anthropologique sur le département du Puy-de-Dome, by M. A. Rouyon. Sur les peuples de l'Afrique Australe. Sur la langue et les traditions des Buschmans, by P. de Jouvençal. Sur deux séries de crânes provenant d'anciennes sépultures indiennes des environs de Bogota, by M. P. Broca.

The want of space prevents more than a mere reference to the following papers and works: N. B. Denny, The Folk Lore of China, 8vo, London. E. A. Freeman, Race and Language; *Contemp. Rev.*, March.

Albert S. Gatschett, Remarks upon the Tonkawa Languages, read before the Am. Phil. Soc. November 17, 1876. Intorno Agli Scavi Archeologici fatti dal Sig. A. Arnoaldi, veli presso Bologna, Osservazioni del Conte Senatore G. Gozzadini; Bologna, 1877. Albin Kohn, Die Bienenkorbgräber bei Wrobelwo, Posen; *Archiv* ix., 4, 1877. A. Ecker, Sur Statistik der Körpergrösse im Grossherzogthum Baden; Ib. Von Baer, Von wo das Zinn zu den ganz alten Bronzen gekommen sein mag? Ib. P. Cazalis de Fondouce, The Palafittes of Laibach Moor; *Matériaux,* 2, 1877. C. Engelhardt, Influence of Classic Industry and Civilization upon those of the North during Ancient Times; Ib. M. Moura, The Age of Stone in Indo-China; Ib. J. Walhouse, On Non Sepulchral Monuments; London Anth. Inst., February 27th. Rev. Thomas Powell, F. L. S., On the Nature and Use of the Vegetable Poisons, employed by the Natives of the Samoan Islands; London Linnæan Society March 15th. Rev. A. C. Cleary, The Problem of Language; Victoria Institute, March 19th. Dr. Crockley Clapham, Brain Weight of the Chinese and Pelew Islanders; London Anth. Inst., March 29th. E. B. Tylor, Review of Spencer's Principles of Psychology; *Mind,* April. J. P. Mahaffey, Modern Excavations; *Contemp. Rev.,* April. Sir. J. Lubbock, Our Ancient Monuments; *Nineteenth Century,* April. The Rationale of Mythology, *Cornhill Mag.,* April. Die Völker Russlands; *Petermann's Mittheil,* I., 1877 (good). William Tegg, Meetings and Greetings: the Salutations, Observances, and Courtesies of all Nations; London, Tegg & Co. — Otis T. Mason.

Note. We shall be glad to receive the titles of papers read before scientific bodies, or published in the journals of our country. — O. T. Mason, Washington, D. C.

## GEOLOGY AND PALÆONTOLOGY.

Influence of Geological Changes on the Earth's Axis of Rotation. — Mr. George H. Darwin has presented a paper on this subject to the Royal Society. He concludes that if the earth be quite rigid, no redistribution of matter in new continents could ever cause the deviation of the pole from its primitive position to exceed the limit of about 3°. But if the view, that the earth readjusts itself periodically to a new form of equilibrium, is correct, then there is a possibility of a cumulative effect; and the pole may have wandered some 10° or 15° from its primitive position, or have made a smaller excursion, and returned to near its old place. No such cumulation is possible, however, with respect to the obliquity of the ecliptic. It is suggested that possibly the glacial period may not have been really one of great cold, but that Europe and North America may have been then in a much higher latitude, and that on the pole retreating they were brought back again to the warmth. There seem to be, however, certain geological objections to this view.

RECENT PALÆONTOLOGICAL DISCOVERIES IN THE WEST. — Prof. O. C. Marsh contributes to the July number of the American Journal of Science and Arts, the results of his studies of the *Coryphodontidæ*, a family comprising the oldest known tertiary mammals, the fossil bones coming from the base of the Eocene formation of Utah, Wyoming, and New Mexico. *Coryphodon* was an Ungulate and among the mammals associated with it were "the equine *Eohippus*, and the suilline *Helohyus*, showing clearly that we must look to Cretaceous strata at least for the parent form of the Ungulates." The paper is accompanied by figures of the skull of Coryphodon, and the feet bones of *Coryphodon* and *Dinoceras*.

(FIG. 84.) RESTORATION OF HESPERORNIS REGALIS MARSH (about one tenth natural size).

The accompanying illustration is a restoration of *Hesperornis regalis*, about one tenth of the natural size. It is a cretaceous bird with teeth, and Professor Marsh on fresh examination finds some additional characters of importance of the order *Odontornithes*, of which it is a type. He also describes a new species of small swimming bird, which comes from the same geological horizon (cretaceous) and has been called by him *Baptornis advenus*. An enormous Dinosaur (*Titanosaurus montanus*) is also described as new from the cretaceous deposits of Colorado.

On the Classification of the Recent and Fossil Fishes. — Professor Cope has recently reviewed the structure of the fossil fishes, and proposed a number of necessary modifications of the system as left by Agassiz in the *Poissons Fossiles.* He has confirmed the views of various naturalists, that the class or sub-class *Ganoidea* of that author consists of heterogeneous materials, which must be distributed in a number of sub-classes. He recognizes four sub-classes of *Pisces:* namely, the *Holocephali*, the *Dipnoi*, the *Selachii*, and the *Hyopomata.* The last named is proposed for that natural assemblage which possess a hyo-mandibular bone articulated with the cranium, a maxillary arch, and no median axis of the basal portion of either pectoral or ventral fins. Under this group he arranges three tribes, namely, the *Crossopterygia* (or *Ganoidea*), the *Chondrostei*, and the *Actinopteri;* the last made up of the *Teleostei* of Müller, and a few recent, and many extinct fishes referred by Agassiz and Müller to the "Ganoidei." Professor Cope shows that Huxley's "suborder *Crossopterygia*," is also a heterogeneous assemblage, many of the forms referred to it belonging to the *Dipnoi*, while others are true *Hyopomata.*

The fossil fishes referred to the *Actinopteri* were found to be most nearly related to the order *Isospondyli;* none of them presenting near affinities to *Lepidosteus*, so far as discoverable. An exception to this statement, is the genus *Dorypterus*, which was regarded as typical of a new order presenting some relationship to Acanthopterygian orders. The order was named the *Docopteri.* The fossil families referred to the *Isospondyli*, are the *Sauropsidæ* (*Sauroidei* Agass. pt.), *Lepidotidæ* (*Lepidoides* Agass. pt.), *Pycnodontidæ* (*Pycnodontes* Agass. pt.), and *Dupediidæ* (*Lepidoides* Agass. pt.)

## MICROSCOPY.

The New Model Illuminating Adjustment. — The plan of mounting the diaphragm, substage, and mirror upon a bar so hinged that they shall all swing concentrically around the object, now successfully and extensively carried out by both Zentmayer and Gundlach, has given rise to an unusually interesting question of priority. The fact that the Rochester stands at the Centennial Exhibition, at the time of its opening, had the mirror stem hinged slightly below the plane of the object, has been not unreasonably, though incorrectly, understood by some writers to indicate that there was at that time no intention to secure fully the advantages of the concentric swing. Mr. Gundlach, however, makes a fully conclusive explanation of the apparent discrepancy. As there is no doubt that Mr. Zentmayer had then completed and made public his invention, it cannot be doubted that both parties fully matured the plan independently.

So simple a device could hardly have escaped the efforts of previous workers. It was foreshadowed in the semi-cylinder of Mr. Tolles, with

its concentrically swinging shutter, and in the radial arm he has talked about for years in connection with the aperture question, and he even made, two years ago, for Dr. G. Bacon, of Boston, a stand with an "accessory carrier" swinging in this manner, but it does not seem to have been so formally published as to be available to the world or to constitute a claim to priority. In 1873 Mr. W. H. Bulloch, of Chicago, an optician who has made many excellent stands, constructed a large stand with the substage traversing around a point one tenth of an inch above the stage (to allow for thickness of object slide), but he did not combine the mirror bar with it, and does not now prefer to do so. Although his model lacked the completeness, simplicity, and facility of management of the latest forms, he came very near accomplishing the result which has since been attained, and contributed an important step in the progress toward that end. He also made, as early as 1870, a mirror bar to swing above the stage for using the mirror (without detaching it) for opaque illumination, and an identical device was employed by Spencer about the same time.[1] Similar arrangements have been used by others, to say nothing of the common expedient of mounting objectives or other illuminating contrivances on a swinging arm on the stand or on a separate base for oblique illumination at various angles which have been employed by the writer and nearly everybody else interested, ever since the subject of oblique illumination became prominent. It is, however, true that such an adjustment never came into general use as a regular part of the stand, and it is nearly equally certain that it is now so established as an important and permanent improvement.[2]

The following is Mr. Gundlach's account of his invention: —

"The construction of a stand with my now well-known fine adjustment, a modification of the glass stages used by many opticians, and finally the hanging of the mirror and other illuminating apparatus in the plane of the object, which had been already planned and announced before the close of the year 1875, was begun about the end of January, 1876, in the factory of the Bausch & Lomb Optical Company, after my arrangements with that company had been effected. In the construction of that stand I had in view the employment of a solid glass stage (not open in the centre), expecting to gain thereby the advantage of very oblique illumination, in consequence of the refraction of the surfaces.

"In order to obtain practically the optical object I had in view in placing the centre of rotation of the illuminating apparatus in the plane of the object, I had to take this refracting power of the solid glass stage into consideration, and consequently had to place the central point of

[1] See Table of American Students' Microscopes, by R. H. Ward, M. D., in the NATURALIST for June, 1872.

[2] The substance of this note was given in Dr. R. H. Ward's address as chairman of the microscopical sub-section of the American Association for the Advancement of Science, at the Buffalo meeting last August.

rotation as much under the actual (mathematical) plane of the object, as the glass stratum of the stage would have lifted the ray.

"Convinced, however, by the criticism of competent judges, and by my own observations, that the solid glass stage (without central opening) offered optical disadvantages which neutralized to a great extent the benefits that could be derived from it, I subsequently abandoned glass stages of that construction, not, however, before a number of stands had been either constructed or were in the course of construction, arranged in regard to the hinging point of the illuminating apparatus in such a manner as to suit a solid glass stage. The point selected by me for the centre of rotation of the illuminating apparatus in these stands would have been optically the correct one, if a solid glass stage of my construction had been employed.

"The stands whose construction was complete at this time, and those in process of construction, were not altered, firstly, because it would have involved considerable expense to do so, secondly, because I deemed the deviation from the actual plane of the object so slight as to be of very little consequence, especially as the actual and mathematically correct plane of the object is variable, owing to variations in thickness of the glass slides, and therefore practically unattainable for the centre of rotation, unless said centre can be made adjustable to it.

"Of these stands so made and left unaltered one was sent, with other microscope stands of our make, to the Philadelphia exhibition, and was there at the opening of the same, and the examination of this stand may have given rise to the impression that I intended to place the centre of rotation of the illuminating apparatus lower than the plane of the object. The other stands, constructed with a view of using the glass stage with central opening, and having the swinging mirror bar hinged slightly above the upper surface of the glass stage, were unfortunately not quite finished at the time the exhibition opened.

"Other stands were then in process of construction, arranged to meet the altered circumstances, and were afterwards exhibited at the Centennial Exhibition in Philadelphia, all of them conceived by me, and executed under my superintendence, before I had seen or heard of Mr. Zentmayer's efforts in the same direction."

SPENCER'S OBJECTIVES. — These celebrated lenses are now made by Charles A. Spencer and Sons, at Geneva, N. Y., and sold by G. S. Woolman, of New York. In addition to the usual first class series, and low angle series, there is an entirely new set called the students' series, of still smaller angle and very low price.

EXCHANGES. — Shell-sand from the Bermuda Islands, for any really valuable material; or selected shells from the same for mountings, of special interest. C. C. MERRIMAN, Rochester, N. Y.

## SCIENTIFIC NEWS.

— A party consisting of Dr. Joseph D. Hooker, K. C. B., Keeper of Kew Botanical Gardens, Gen. Strachey of India, Prof. Asa Gray and Prof. Joseph Leidy, have, as guests of the U. S. Geological Survey of the Territories, accompanied Prof. F. V. Hayden to Colorado, and will visit Utah and the Pacific Coast.

— The army officers at Fort Walla Walla, Washington Territory, have organized the Walla Walla Association for the Advancement of Science, Surgeon George M. Sternberg, U. S. A., being the first president. This is a new step for the military to take, and one in a good direction. We wish the new society all usefulness and success.

— Dr. Philip Pearsall Carpenter died on the 24th of May at his residence in Montreal, Canada, of typhoid fever, at the age of fifty-seven. He was born at Bristol in England, into the family of the well-known Dr. Lant Carpenter, among whose eminent children, Dr. W. B. Carpenter, Miss Mary Carpenter, and the subject of this notice, are best known. Dr. P. P. Carpenter was educated as a clergyman, and may be said to have never left off the clerical mantle, so far as a continuance of earnest labors in all matters of moral and sanitary reform may be concerned. There can be no doubt that his unceasing and enthusiastic work in this direction curtailed his opportunities for scientific study and indirectly brought about his premature death.

As a student of nature Dr. Carpenter's attention was chiefly directed to the mollusca, and especially to those of the west coast of America. The systematic study of this fauna was begun by him, and his work has rendered it practicable for others to follow him with a vast decrease of labor and bibliographical research. Thorough, careful, conscientious, frank, his reports and papers on this fauna will ever remain as his best monument.

He also gave particular attention to the *Pandoridæ*, *Cæcidæ*, and *Chitonidæ*, each of which groups he monographed in a thorough manner. The last mentioned work is yet unprinted, but is believed to be in a condition so complete as to leave little doubt that it will be published, as originally announced, by the Smithsonian Institution. It is a very remarkable monograph, and the first successful attempt to illuminate the darkness which has obscured the group of *Chitonidæ*. Malacologists are to be congratulated that this, the author's last, and in many respects most valuable effort, is not to be lost. Personally, he worked for righteousness in all his doings; no one could know without respecting the man, though his fiery enthusiasm was not always appreciated or understood. And beneath a thoroughly English bluntness of character lay an almost womanly tenderness for sorrow, ignorance, or need, in others. He married, in 1860, Miss Minna Meyer of Hamburg, a lady who has proved a helpmeet in all the work of his life, and who survives him.

He left no children and for the greater portion of his life was in very moderate circumstances. — W. H. Dall.

— Col. Ezekiel Jewett of Utica, New York, died at Santa Barbara, California, on the eighteenth of May, of pneumonia, at the age of nearly ninety years. A field naturalist rather than an author, as his martial career necessitated, Colonel Jewett was best known to those who have enjoyed his society in camp or on a collecting tour. A man of leonine bearing, tall and soldierly aspect, of brilliant conversational powers and frank and generous disposition; he combined with these a great amount of practical knowledge in some branches of science. Few were more conversant, at one time, with the fossils of New York, and he was thoroughly familiar with the marine mollusca of North America up to a pretty recent date. He was for many years curator of the New York State Cabinet of Natural History, and held other offices of trust. In literature he will be chiefly recalled by the references to collections of his making on which numerous papers by naturalists have been based. Personally he was a man whom to know was to honor and love, and he formed one of the last links between the laborers for science of his own and the present generation, a period covering more than half a century. — W. H. Dall.

— In a circular issued from the Surgeon-General's office Dr. Elliott Coues, U. S. A., asks the medical officers of the army, and others interested, to coöperate with him in the preparation of a work to be entitled History of North American Mammals, to be published by the government. Dr. Coues desires information regarding the geographical distribution of our mammals; to this end it is desirable that lists should be prepared of the various species found in any given locality, with notes on their relative abundance or scarcity, times of appearance and disappearance, the nature of their customary resorts, etc. The habits of many of the *smaller*, insignificant, or obscure species are almost entirely unknown. Full and accurate information respecting the habits of the numerous species of hares, squirrels, shrews, moles, mice, rats, bats, weasels, gophers, etc., is particularly desired. The bats offer a peculiarly inviting and little-explored field of research. Among points to which attention may be directed, in any case, are the following: —

Date and duration of the rut. Period of gestation. Usual time of reproduction. Number of young produced. Duration of lactation. Care of the young, by one or both parents. State of monogamy or polygamy. Times of disappearance and reappearance of such animals as are migratory, and of such as hibernate. Completeness or interruption of torpidity. Times of changing pelage, of acquiring, shedding, and renewing horns. Habits connected with these processes. Habits peculiar to the breeding and rutting seasons. Construction of nests, burrows, or other artificial retreats. Natural resorts at different seasons. Nature of food at various seasons; mode of procuring it; laying up of supplies;

quantity required. Various cries, of what indicative. Natural means of offense and defense, and how employed. General disposition, traits, characteristics. Methods of capturing or destroying, of taming or domesticating. Economic relations with man; how injurious or beneficial, to what extent, used for what purposes, yielding what products of value. Specimens, after examination by the undersigned for the purposes of the work in hand, will be deposited, in the name of the donor, in the Army Medical Museum or in the National Museum. Address Dr. Elliott Coues, Office of United States Geological and Geographical Survey of the Territories, Washington, D. C.

— The Netherlands Zoölogical Association have founded an establishment on the Dutch coast, where investigations of the fauna and flora of the North Sea can be carried on at leisure. The building is made of wood, and can be transported from one place to another, according to season and varying abundance of material for study.

— In some parts of California the tomato is perennial. A resident at Los Angeles now (February) gathers ripe tomatoes from the top of a twenty-foot ladder. The vine, which is twenty-five feet high, has been trained on the sunny side of the house, and shows blossoms and fruit in every stage of growth.

— In various parts of California experiments are being made in a small way with the cork-bark oak; and the trees are reported thus far as doing well. In Santa Barbara a fine, large, and thrifty specimen may be seen in a garden, which has grown from a seed planted twenty-two years ago.

— A farmer in Tulare County, California, has been in the habit of using for fuel the stalks of castor-beans growing on his ranch, and finds them a very ready and desirable substitute for wood, the trunks of the larger ones being about the size of a man's leg. The immense growth of this plant in a single year and its prolific bearing qualities make it a desirable crop.

— Mr. D. G. Elliot is about to publish in London two monographs, one on the *Felidæ*, including both the living and extinct species; the other on the *Bucerotidæ*, or Hornbills.

— Mr. Robert J. Creighton, resident agent in San Francisco for New Zealand, shipped early in February, by the Zealandia, a box of white-fish eggs, containing 180,000, on account of that colony. This is the second shipment of white-fish eggs to New Zealand, obtained through the United States Fish Commissioners, who pack and ship them from Lake Michigan to San Francisco. Mr. Creighton likewise forwarded for the same colony a parcel of trout eggs from the Cold Spring Trout Ponds, Charlestown, New Hampshire, and Mr. Hugh Craig, agent of the New Zealand Ins. Co., forwards on account of the Auckland Acclimatization Society two California deer and twenty-seven short-tailed grouse from Utah Territory. By the next steamer Mr. Craig will forward prairie

chickens, Oregon grouse, Oregon pheasants, and an elk for the same destination. Mr. Thomas Russell, President of the New Zealand Bank, makes a present of these animals to the Auckland Acclimatization Society.

— About four miles from San Buenaventura, California, on the river of that name, is a grape-vine of the Mission variety, the stem of which measures forty inches in circumference. It covers an area of about eighty feet in diameter. This vine yields about one thousand pounds of grapes annually. The clusters of fruit will measure from twelve to sixteen inches in length, and average three and a half pounds. It is on the ranch of Don Jose Moraga, and was planted by that gentleman seventeen years ago.

— A Natural History Review, to be called Termésretrajzi Füretek (Naturhistorische Hefte), to be edited in German, was issued from the National Museum of Buda-Pesth, Hungary, about January 1, 1877. It contains papers on Zoölogy, Botany, Mineralogy, and Geology. Articles may be printed in various languages, but extracts literally translated will be given in the Hungarian text. It will be devoted wholly to Hungarian matters.

— A circular was issued December 30, 1876, by the National Society of Natural Sciences of Cherbourg, France, announcing the twenty-fifth anniversary of its foundation, and expressing great gratitude to the learned societies and its corresponding members for numerous congratulatory letters on their jubilee, which it regards as precious testimonials of esteem.

— The following facts I learned from Dr. Clark Nettleton, who now resides in Racine. It is too good a story to be lost: —

One morning in the latter part of February, 1832, the U. S. schooner Shark, Lieutenant Pierce commander, having Audubon and party on board, anchored in Cote-Blanche Bay, at the mouth of Bayou Salie, Louisiana. The scientists here left the schooner, rowed up the bayou in her boats and landed on Michael Gordie's sugar plantation.

Audubon made many inquiries about birds, where they could be found, where they roosted, etc., and all day the report of fire-arms was heard among the reeds and swamps where the men were busy procuring specimens of the birds that were so numerous there at that time.

Gordie was greatly alarmed. He consulted his overseer and interrogated the blacks with whom Audubon had talked. The conclusion was that the strangers were pirates, and that he would be robbed that night and perhaps lose his life. Thus he reasoned: "The black craft is armed, — has guns. No sane man would engage in such trifling occupation as shooting worthless little birds. This is evidently a ruse gotten up to deceive me."

So, as there was no chance of procuring assistance, the plantation being isolated by swamps and the bay, he hid his gold, secreted his

family, and barricaded the house. He then armed all hands, not a small number either, with guns, pitch-forks, cane-cutters, — everything, in short that might be of service in the emergency, and these all stood at their assigned posts, during the entire night, in the momentary expectation of an attack.

Day came, and the *piratical craft* weighed anchor and left the bay, to the great relief of the wealthy planter and his domestic army. The excitement, fear, and suspense were too much for him however. He was taken sick, and sent for his family physician, Dr. Nettleton, who lived twenty miles distant. The doctor had been apprised of Audubon's visit and had a good laugh at the expense of poor Gordie. — Dr. P. R. Hoy, Racine, Wis.

— Our readers will be pained to learn of the sudden death by apoplexy of Prof. Sanborn Tenney, July 9th, while on his way West to meet the members of the Williams College Expedition to the Rocky Mountains. We learn that the Expedition will consequently return. Professor Tenney was author of a Manual of Geology and of two on Zoölogy, which have been extensively used in schools; he also published a number of articles on geological and zoölogical subjects. He was born in Stoddard, N. H., January 13, 1827.

— A dispatch to the San Francisco papers from Los Angeles, California, under date of the 12th of June, says: A volcanic eruption occurred in the mountains opposite Flowing Wells, a station on the Southern Pacific, about sixty miles from Yuma, at 9 o'clock yesterday morning. It was preceded by a violent vibration of the earth, about half an hour after which a dense volume of smoke and huge black and broken bowlders were observed to issue from the mountains. It continued in an active state all day, but became nearly passive at nightfall. Subsequent dispatches confirmed the above, and a recurrence of the eruption is reported.

— After delays which the editors of *Psyche*, the only American journal of entomology in existence, except the Canadian Entomologist, could not avoid, the first numbers of the second volume have been issued to subscribers. The second volume will be made superior in quality and in quantity to the first. Subscriptions are earnestly desired, in order that the almost inevitable drain upon the purses of the publishers may be as small as possible. We regret to learn that the first volume of this valuable little journal cost more than two hundred dollars beyond the receipts from subscriptions, and the editor had to pay most of the deficit. The subscription price to either the first or the second volume (embracing three years each) is three dollars.

— The Woodruff Scientific Expedition around the world proposes to sail in October, and return in October, 1879. We have received the "Final Announcement," a pamphlet of thirty-nine pages, with a map of the route.

— From the report of a recent lecture by Prof. A. E. Verrill on the construction and arrangement of the new Peabody Museum at Yale College, with especial reference to the zoölogical department, we learn that the collections are nearly arranged. The first story is devoted to geology and mineralogy, the second to palæontology, and the third to zoölogy. Prof. Verrill's laboratory is 42 by 22 feet, and Prof. Smith's 36 by 26 feet. They are on the same floor with the collections. The cases in the exhibition rooms are probably superior to those in any museum in this country. Their special merits are, first, *tightness*, to prevent access of dust and moths; second, transparency, to give the best possible view of the contents, which has been accomplished by the use of the best plate glass both in the sides and ends, and by reducing the woodwork to the smallest size compatible with requisite strength. To make the cases as tight as possible the doors are provided with tongue and groove, with patent locks that bolt the doors at top and bottom. In the zoölogical department the cases have also been decidedly improved in this respect by the use of sheet-zinc for backs. Another peculiar feature, quite novel, so far as known, is the use of large panes of ground-glass, ground on both sides, and set in movable sash, for the central divisions in the alcove cases. This gives an admirable background for the specimens, and also gives increased light in the room. Moreover, such backs are not liable to the unsightly shrinkage cracks so frequently seen in wooden backs.

— Mr. Edwin Bicknell, well known for his skill in practical microscopy, died at Lynn, Mass., March 19th, aged forty-seven years. Mr. Bicknell became interested in work with the microscope about twenty years ago, and his first specimens were prepared at the Portland Society of Natural History, in Maine, his native State. He soon acquired great reputation as a preparer of injected specimens and rock sections; and his examples of these objects have never been surpassed. He succeeded Mr. Glen as microscopist to the Museum of Comparative Zoölogy, under the late Professor Agassiz, and went to the Penikese School as demonstrator of the microscope. He also took a prominent part in the meetings of the Microscopical Sections of the Boston Society of Natural History, and the American Association for the Advancement of Science. His connection with Cambridge ceased at the death of Agassiz, and for a while he resided in Salem, Mass., where he had before held a place in the Essex Institute Microscopical Works. His last work was in the illustration by microscopic projections of various scientific lectures. Mr. Bicknell was a laborious student of the theory and history of the microscope, and leaves a very fine library of books, old and new, on his favorite subject. — E. C. Bolles.

— Catalogus Polyglottus Historiæ Naturalis a Carolo Gilberto Wheeler, Professore in Universitati Chicagensi, is the title of a folio giving the names in English, Latin, Italian, French, and German of a

number of animals and minerals taken at random. What could have induced any one to spend his time in such utterly unprofitable work as this, we are at a loss to imagine.

— Dr. John S. Bowerbank, well known for his researches in the sponges, died at the age of eighty, March 8th. Professor Panceri recently died while lecturing to his class at Naples.

## PROCEEDINGS OF SOCIETIES.

Boston Society of Natural History. — April 18th. Mr. C. S. Minot made a communication on the primitive homologies of the animal kingdom, based on a new theory of the germinal layers.

May 2d. Mr. S. W. Garman read a paper on the pelvis of Selachians, with especial reference to that of the genera Potamotrygon and Disceus.

May 16th. Mr. M. E. Wadsworth remarked on the fusibility of some forms of quartz; on the mineralogy and petrography of Boston and vicinity, and on the granite of North Jay, Me. Mr. Scudder described a fossil cockroach probably from Pennsylvania, and referred to some points hitherto overlooked in the structure of the book-louse.

American Geographical Society. — New York, May 7th. Mr. J. A. Johnson lectured upon Some Geographical Features of California, and Mr. A. R. Conkling read a paper entitled A Summer's Exploration in the Sierra Nevada.

May 22d. Addresses were made on the Exploration and Civilization of the Interior of Africa and the Suppression of the Slave Trade, by Revs. J. B. Pinney, H. W. Bellows, Prof. A. Crummels, Paul B. Du Chaillu, and Judge Daly.

Appalachian Mountain Club. — Boston, June 13th. Mr. J. R. Edmands exhibited his improved camera for mountain surveying. Mr. W. H. Pickering showed a new form of plane-table for the same purpose. Prof. C. R. Cross described some measurements of heights by the barometer. On June 16th the club joined the Lexington Field and Garden Club in a field-meeting, at Lexington.

Academy of Natural Sciences. — Philadelphia, May 22d. Dr. Koenig placed on record the occurrence of enstatite associated with corundum from Lincoln County, Georgia, received for examination from Dr. Foote.

Mr. John Ford described a group of eight burial mounds examined by him on the lands of Mr. E. P. Ford, on Coups Creek, Macoupin County, Illinois. The scene presented upon opening the third grave was somewhat startling in character. Four skeletons set within it, two and two; their arms crossed, the knees of one pair pressing sharply against the backs of the other, and the faces of all, like those in the central grave, turned directly towards the east. The enveloping earth

was not so dense nor the quantity so large in proportion as in the other graves, so that most of the upper parts of the skeleton were exposed to view upon lifting the covering slab. In addition to the human remains nothing was found except four large marine shells, known as the *Busycon perversum* of Linnæus. The position of each of these in relation to the bodies was the same. The canal or smaller end of the shell had been placed in the right hand of each individual, while the larger portion rested in the hollow above the left hip. But more remarkable than this was the fact that within each of the shells had been packed what appeared to be the bones of a child, the skull, which evidently had been crushed before burial, protruding beyond the aperture. It was difficult to resist the conclusion that these infants were sacrificed as offerings to the spirits of the dead whom the living desired to honor.

Dr. Leidy remarked that while strolling along the sandy beach at Cape May, N. J., he observed that in a number of places, where the water of hollow beds had sunken away in the sands, a thin, yellowish-green film colored the surface. A portion of this green matter was scraped up and put in a bottle with sea water. The heavier sand subsided and the green matter remained in suspension, giving the water an olive-green color, reminding one of the colored turbid liquor decanted from a jar of stale preserved olives. The color was suspected to be due to the presence of diatoms, but on microscopic examination it proved to be caused by multitudes of a greenish monad, probably pertaining to the genus Chilomonas. The minute flagellate infusorian is discoid oval in form, with a slight emargination laterally. This emargination seems to indicate the position of the mouth, and from it projected a single delicate flagellum, or thread, scarcely distinguishable. The little creature moved active forward, rolling over from one side to the other, and rapidly vibrating the flagellum. Under a high power the animal appeared transparent and nearly colorless, with two or three balls, of yellowish green hue, and several transparent, colorless, and well-defined globules. The size of the monad ranged from 1-4000 to 1-2400 of an inch in length, but what they lacked in size they made up for in numbers, large patches of the beach being colored by them.

California Academy of Sciences. — May. By Mr. J. A. Hosmer a skull and stone mortar was presented. They were found on Anacapa Island, at the base of an artificial shell mound, the mound one of a number, and the shells chiefly those of abalone (Haliotis) and (Mytilus) mussel. Fragments of flint were scattered around, evidently left there by arrow-makers. Fossils of leaves from the intercalated clays in the auriferous gravels, near Blue Tent, Nevada County, were presented by D. P. Hughes. Mr. S. B. Christy, of the University of California, read a paper entitled Some Notes on the Mount Diablo Coal Mines, etc. It gave an analysis of the various grades of coal in the Mount Diablo field, and in those of Livermore Valley, California, and Washington Territory.

Mr. R. E. C. Stearns read a memorial sketch of the life and scientific services of the late Col. Ezekiel Jewett, who died at Santa Barbara, California, on the 18th of May, at the age of eighty-six years.

Through inadvertence we omitted to state that the wood-cuts illustrating Prof. Russell's article "Concerning Footprints" in the July number, were kindly loaned by Messrs. Ivison, Blakeman, Taylor, & Co., the publishers of Dana's Manual of Geology, from which the cuts were taken.

Professor E. S. Morse is now in Japan studying the anatomy and development of the Brachiopods. He will be absent from the country until October.

A Manual of the Anatomy of the Invertebrated Animals by Prof. T. H. Huxley will be issued in August, by J. & A. Churchill, London.

## SCIENTIFIC SERIALS.[1]

American Journal of Science and Arts. — July. Germination of the Genus Megarrhiza, by A. Gray. On the Relations of the Geology of Vermont to that of Berkshire, by J. D. Dana. Characters of Coryphodontidæ, by O. C. Marsh. Characters of Odontornithes, by O. C. Marsh. New and Gigantic Dinosaur, by O. C. Marsh.

The Geographical Magazine. — June. The Arctic Expedition, xv. Work of the Auxiliary Sledge Parties. The Seat of War in Asia, Corea, by S. Mossman. The India-Rubber Trees in Brazil, by R. Cross.

The Geological Magazine. — May. A Visit to the Active Volcano of Oshima, by J. Milne. June. — On the Rocks of Newfoundland, by J. Milne, with Critical Notes by A. Murray. Baron C. von Ettinghausen's Theory of the Development of Vegetation on the Earth, by J. S. Gardner.

Quarterly Journal of Microscopical Science. — July. Résumé of Recent Contributions to our Knowledge of Fresh-Water Rhizopoda, Part IV., by W. Archer. Notes on the Structure of several Forms of Land Planarians, etc., by H. N. Moseley.

Annals and Magazine of Natural History. — May. Malacological Notes, by R. Garner. On the Final Stages in the Development of the Organs of Flight in the Homomorphic Insecta, by J. Wood-Mason. June. — On the Variability of the Species in the Case of Certain Fishes, by V. Fatio. On Ascodictyon, a New Provisional and Anomalous Genus of Palæozoic Fossils, by H. A. Nicholson. On Rupertia Stabilis, a New Sessile Foraminifer from the North Atlantic, by G. C. Wallich.

The Quarterly Journal of Conchology. — May. Review of the Genus Tulotoma, by A. G. Wetherby.

[1] The articles enumerated under this head will be for the most part selected.